Environmental Enrichment for Nonhuman Primates Resource Guide

January 1992 – February 1999

AWIC Resource Series No. 5

ISSN 1082-9644

Environmental Enrichment for Nonhuman Primates Resource Guide

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Published March 1999

Published by:
United States Department of Agriculture
Agricultural Research Service
National Agricultural Library
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Partial funding for this document comes from National Institutes of Health, Office for Protection from Research Risks, Division of Animal Welfare.

National Agricultural Library Cataloging Record:

Environmental enrichment for nonhuman primates resource guide: January 1992-February 1999.
(AWIC resource series no. 5)
1. Primates -- Enrichment -- Bibliography. 2. Primates -- Behavior -- Bibliography. 3. Primates -- Husbandry -- Bibliography. 4. Primates -- Enhancement -- Bibliography. 5. Primates -- Care -- Bibliography.
I. Kreger, Michael D. II. Animal Welfare Information Center (U.S.) III. Title.
aHV4701.A94 no.5

About the cover: Rhesus macaque (*Macaca mulatta*) photo by Mary Lassanyi.

Environmental Enrichment for Nonhuman Primates
Resource Guide

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Acknowledgements

The editor acknowledges the assistance of Nelson Garnett and Carol Wigglesworth of the Office for Protection from Research Risks, Viktor Reinhardt of the Animal Welfare Institute, Joanne Oliva-Purdy of the Baltimore Zoo, and Ray Hamel of the Primate Information Center for their review of this document and useful suggestions. D'anna Jensen helped with layout. Partial funding for this document comes from National Institutes of Health, Office for Protection from Research Risks (OPRR), Division of Animal Welfare.

A Message from OPRR

The National Institutes of Health has demonstrated a long-standing commitment to support AWIC's development of these resource documents. Earlier versions have proved to be beneficial to researchers and Institutional Animal Care and Use Committees as they implement the PHS Policy on Humane Care and Use of Laboratory Animals and comply with the Animal Welfare Act amendments that require environmental enrichment for nonhuman primates. This updated version will serve as a valuable compilation of literature on environmental enrichment since 1992. The NIH Office for Protection from Research Risks is pleased to have had an opportunity to contribute to the development of this significant resource.

Introduction

The Library of Congress defines environmental enrichment as "enhancing the environment of confined animals in order to encourage natural behaviors and improve their quality of life." Environmental enrichment, also called behavioral enrichment, includes increasing the complexity of an otherwise unstimulating animal enclosure. This can include adding manipulable objects such as balls or boards for grooming and foraging, novel odors or food, or housing animals in compatible social groups. Environmental enrichment is a tool that can be used to improve the animal's psychological well-being by stimulating the ability to cope with daily changes in the social and physical environment, engaging the animal in species-typical behaviors, and reducing or eliminating maladaptive or pathological behaviors.

Environmental enrichment for nonhuman primates is not a recent concept. Zoo managers have long known about the benefits of a stimulating environment. In 1906, William Temple Hornaday, Director of the New York Zoological Park, encouraged visitors to come see the gorilla before it dies from "sullenness" and "lack of exercise". He did not expect the gorilla to live more than five months in captivity and relied on regular shipments of wild-caught nonhuman primates to replenish the zoo's stock. Carl Hagenbeck, the animal dealer and zoo director who introduced the world to naturalistic zoo exhibits and positive reinforcement training, wrote in 1910, "In order to keep great apes in sound health, it is necessary to provide them with plenty of society, either of their own or of some other. In the case of all animals in captivity, it is of first importance to take measures for combating the tedium from which they would otherwise suffer." (*Beasts and Men*, page 287). Zoos have since become acutely aware of the importance of environmental enrichment in terms of exhibiting well-adjusted animals to the public, improving breeding of rare species, and as a tool for preparing captive-reared endangered species for reintroduction to the wild.

As nonhuman primates have become models for human and animal health, researchers have realized that a high quality social and physical environment for primates in the laboratory is essential to research. Pioneers in environmental enrichment for laboratory primates such as Kathryn Bayne, Scott Line, Melinda Novak, and Viktor Reinhardt have demonstrated the value and complexity of enhancing the animal environment given the cotexts of biomedical research objectives, species, and individual animal life histories. They have shown that enriched environments can improve data collection as the data are not confounded by hormonal or behavioral indicators of distress. The research is more humane by reducing pain and distress to the animal and it may actually cost less (ie particularly if enriching the environment leads to breeding).

Besides the humane, scientific, and economic reasons to enrich the environment of nonhuman primates, there is now a legal reason. In the 1985 amendments to the Animal Welfare Act, the U.S. Congress required that minimum requirements be established "for a physical environment adequate to promote the psychological well-being of primates." The U.S. Department of Agriculture developed regulations to meet that mandate stipulating, "Dealers, exhibitors, and research facilities must develop, document, and follow an appropriate plan for environment enhancement adequate to promote the psychological well-being of nonhuman primates. The plan must be in accordance with the currently accepted professional standards as cited in appropriate professional journals or reference guides, and as directed by the attending veterinarian." (9CFR, Sec. 3.81)

In addition to the Animal Welfare Act, those who receive funding from the Public Health Service or are accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC) must also comply with The *Guide for the Care and Use of Laboratory Animals*, which is based on a performance standards approach. The *Guide* contains sections related to environmental enrichment.

There is still a need for information about environmental enrichment for nonhuman primates. Recently published research, organization contacts, websites provide guidance to those who are familiar with nonhuman primate care and use and to those who wish to develop expertise. The topic is of such importance to the animal research community, that the National Research Council covened the Committee on Well-being of Nonhuman Primates to review the literature and produce guidelines. The resulting publication is *The Psychological Well-being of Nonhuman Primates* (1998, National Academy Press: Washington, D.C. and available on the web at: http://www.nap.edu/readingroom/reader.cgi?auth=free&label=ul.book.0309052335). USDA, Animal and Plant Health Inspection Service, Office of Animal Care is also reviewing the Animal Welfare Act regulations in order to clarify the regulations and provide guidance to the regulated community.

How to Use This Document

This publication updates and expands *Environmental Enrichment Information Resources for Nonhuman Primates: 1987-1992.* It is current though March 1999 and covers literature published since January 1992. As a resource manual, it is intended to be used for understanding the current regulations, developing ideas for enrichment applicable to laboratory and zoo settings, and introducing the reader to organizations and publications that can help in the design of the enrichment plan or give access to additional resources. This expanded version of the 1992 document contains the full text of relevant sections of the legislation, more organizations, websites and listservs, and a listing of all U.S. primate centers.

This resource guide is not comprehensive. There may be organizations that were not included or references that were not apparent in multidatabase searches. With the exception of the laws and regulations, none of the organizations or products mentioned in the document are endorsed by the U.S. Department of Agriculture.

Bibliographic citations are categorized taxonomically and may be cross-referenced in one of the general sections. It is current through December 1998. Although an effort has been made to ensure that articles are unique to each section, there is considerable overlap due to the scope of the individual articles. Information about specific techniques, such as the use of foraging boards, may be found in several sections.

Call numbers are included for publications contained in the collection of the National Agricultural Library (NAL). While NAL does not sell audiovisuals or publications from its collection, materials may be borrowed by interlibrary loan. Borrowing information can be found on the NAL website http://www.nal.usda.gov/ddsb/

Please note that organizations often relocate and professional society addresses and contacts change following society elections. All websites and contacts are current as of March 1999.

Animal Welfare Information Center Newsletter articles have been included which discuss some of the issues mentioned in the bibliography. Although the articles have been approved by USDA for inclusion in the newsletter and have been reviewed editiorially, they have not been peer reviewed. The views expressed are those of the authors of the articles and do not represent the views of the U.S. Department of Agriculture or the National Institutes of Health.

United States Laws, Regulations, and Policies for Environmental Enhancement for Nonhuman Primates

In the 1985 amendments to the Animal Welfare Act (Improved Standards for Laboratory Animals Act), Congress included mention of "psychological well -being" for nonhuman primates. This phrase appears nowhere else in the Animal Welfare Act. Because of the difficulty in defining the phrase, U.S. Department of Agriculture enforcers of the Act at the Animal and Plant Health Inspection Service, Office of Animal Care were charged with defining the terms and developing regulations that ensure a physical environment that promotes primate well-being. Included below are the text from the *Animal Welfare Act* and the final version of the regulations as they appear in the *Code of Federal Regulations*. The published (*Federal Register*) USDA response to comments from the public on the proposed regulations can be found in **Appendix A** of this document.

In addition to the Animal Welfare Act, those who receive funding from the Public Health Service or are accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC) must also comply with The *Guide for the Care and Use of Laboratory Animals*, which is based on a performance standards approach. The 1996 Guide is intended to assist institutions in caring for and using animals in ways judged to be scientifically, technically, and humanely appropriate. The Guide is also intended to assist investigators in fulfilling their obligation to plan and conduct animal experiments in accord with the highest scientific, humane, and ethical principles. The recommendations are based on published data, scientific principles, expert opinion, and experience with methods and practices that have proved to be consistent with high-quality, humane animal care and use. The *Guide* contains standards related to environmental enrichment in the section "Animal Environment, Housing and Management."

Animal Welfare Act as amended (7 U.S.C. §§ 2131 et. seq.)

Section 13. (a)(1) The Secretary shall promulgate standards to govern the humane handling, care, treatment, and transportation of animals by dealers, research facilities, and exhibitors.

(2) The standards described in paragraph (1) shall include minimum requirements--
(B) for exercise of dogs, as determined by an attending veterinarian in accordance with the general standards promulgated by the Secretary, and for a physical environment adequate to promote the psychological well-being of primates.

Title 9, *Code of Federal Regulations*, Subchapter A, Section 3.81

§ 3.81 Environment enhancement to promote psychological well-being.

Dealers, exhibitors, and research facilities must develop, document, and follow an appropriate plan for environment enhancement adequate to promote the psychological well-being of nonhuman primates. The plan must be in accordance with the currently accepted professional standards as cited in appropriate professional journals or reference guides, and as directed by the attending veterinarian. This plan must be made available to APHIS upon request, and, in the case of research facilities, to officials of any pertinent funding agency. The plan, at a minimum, must address each of the

following:

(a) *Social grouping*. The environment enhancement plan must include specific provisions to address the social needs of nonhuman primates of species known to exist in social groups in nature. Such specific provisions must be in accordance with currently accepted professional standards, as cited in appropriate professional journals or reference guides, and as directed by the attending veterinarian. The plan may provide for the following exceptions:

(1) If a nonhuman primate exhibits vicious or overly aggressive behavior, or is debilitated as a result of age or other conditions (e.g., arthritis), it should be housed separately;

(2) Nonhuman primates that have or are suspected of having a contagious disease must be isolated from healthy animals in the colony as directed by the attending veterinarian. When an entire group or room of nonhuman primates is known to have or believed to be exposed to an infectious agent, the group may be kept intact during the process of diagnosis, treatment, and control.

(3) Nonhuman primates may not be housed with other species of primates or animals unless they are compatible, do not prevent access to food, water, or shelter by individual animals, and are not known to be hazardous to the health and well-being of each other. Compatibility of nonhuman primates must be determined in accordance with generally accepted professional practices and actual observations, as directed by the attending veterinarian, to ensure that the nonhuman primates are in fact compatible. Individually housed nonhuman primates must be able to see and hear nonhuman primates of their own or compatible species unless the attending veterinarian determines that it would endanger their health, safety, or well-being.

(b) *Environmental enrichment.* The physical environment in the primary enclosures must be enriched by providing means of expressing noninjurious species-typical activities. Species differences should be considered when determining the type or methods of enrichment. Examples of environmental enrichments include providing perches, swings, mirrors, and other increased cage complexities; providing objects to manipulate; varied food items; using foraging or task-oriented feeding methods; and providing interaction with the care giver or other familiar and knowledgeable person consistent with personnel safety precautions.

(c) *Special considerations.* Certain nonhuman primates must be provided special attention regarding enhancement of their environment, based on the needs of the individual species and in accordance with the instructions of the attending veterinarian. Nonhuman primates requiring special attention are the following:

(1) Infants and young juveniles;

(2) Those that show signs of being in psychological distress through behavior or appearance;

(3) Those used in research for which the Committee-approved protocol requires restricted activity;

(4) Individually housed nonhuman primates that are unable to see and hear nonhuman primates of their own or compatible species; and

(5) Great apes weighing over 110 lbs. (50 kg). Dealers, exhibitors, and research facilities must include in the environment enhancement plan special provisions for great apes weighing over 110 lbs. (50 kg), including additional opportunities to express species-typical behavior.

(d) *Restraint devices.* Nonhuman primates must not be maintained in restraint devices unless required for health reasons as determined by the attending veterinarian or by a research proposal approved by the Committee at research facilities. Maintenance under such restraint must be for the shortest period possible. In instances where long-term (more than 12 hours) restraint is required, the nonhuman primate must be provided the opportunity daily for unrestrained activity for at least one continuous hour during the period of restraint, unless continuous restraint is required by the research proposal approved by the Committee at research facilities.

(e) *Exemptions.* (1) The attending veterinarian may exempt an individual nonhuman primate from participation in the environment enhancement plan because of its health or condition, or in consideration of its well-being. The basis of the exemption must be recorded by the attending veterinarian for each exempted nonhuman primate. Unless the basis for the exemption is a permanent condition, the exemption must be reviewed at least every 30 days by the attending veterinarian.

(2) For a research facility, the Committee may exempt an individual nonhuman primate from participation in some or all of the otherwise required environment enhancement plans for scientific reasons set forth in the research proposal. The basis of the exemption shall be documented in the approved proposal and must be reviewed at appropriate intervals as determined by the Committee, but not less than annually.

(3) Records of any exemptions must be maintained by the dealer, exhibitor, or research facility and must be made available to USDA officials or officials of any pertinent funding Federal agency upon request.

(Approved by the Office of Management and Budget under control number 0579-0093)

Guide for the Care and Use of Laboratory Animals

National Research Council (1996). *Guide for the Care and Use of Laboratory Animals.* National Academy Press: Washington, D.C., 127p.

Animal Environment, Housing and Management

Proper housing and management of animal facilities are essential to animal well-being, to the quality of research data and teaching or testing programs in which animals are used, and to the health and safety of personnel. A good management program provides the environment, housing, and care that permit animals to grow, mature, reproduce, and maintain good health;
provides for their well-being; and minimizes variations that can affect research results. Specific operating practices depend on many factors that are peculiar to individual institutions and situations. Well-trained and motivated personnel can often ensure high-quality animal care, even in institutions with less than optimal physical plants or equipment.

Many factors should be considered in planning for adequate and appropriate physical and social environment, housing, space, and management. These include

1. The species, strain, and breed of the animal and individual characteristics, such as sex, age, size, behavior, experiences, and health.
2. The ability of the animals to form social groups with conspecifics through sight, smell, and possibly contact, whether the animals are maintained singly or in groups.
3. The design and construction of housing.
4. The availability or suitability of enrichments.
5. The project goals and experimental design (e.g., production, breeding, research, testing, and teaching).
6. The intensity of animal manipulation and invasiveness of the procedures conducted.
7. The presence of hazardous or disease-causing materials.
8. The duration of the holding period.

Animals should be housed with a goal of maximizing species-specific behaviors and minimizing stress-induced behaviors. For social species, this normally requires housing in compatible pairs or groups. A strategy for achieving desired housing should be developed by animal-care personnel with review and approval by the IACUC. Decisions by the IACUC in consultation with the investigator and veterinarian, should be aimed at achieving high standards for professional and husbandry practices considered appropriate for the health and well-being of the species and consistent with the research objectives. After the decision-making process, objective assessments should be made to substantiate the adequacy of animal environment, husbandry, and management.

The environment in which animals are maintained should be appropriate to the species, its life history, and its intended use. For some species, it might be appropriate to approximate the natural environment for breeding and maintenance. (Chapter 2, pages 21-22)

Naturalistic Environments

Areas like pastures and islands afford opportunities to provide a suitable environment for maintaining or producing animals and for some types of research. Their use results in the loss of some control over nutrition, health care and surveillance, and pedigree management. These limitations should be balanced against the benefits of having the animals live in more natural conditions. Animals should be added to, removed from, and returned to social groups in this setting with appropriate consideration of the effects on the individual animals and on the group. Adequate supplies of food, fresh water, and natural or constructed shelter should be ensured. (Chapter 2, page 25)

Structural Environment

The structural environment consists of components of the primary enclosure-cage furniture, equipment for environmental enrichment, objects for manipulation by the animals, and cage complexities. Depending on the animal species and use, the structural environment should include resting boards, shelves or perches, toys, foraging devices, nesting materials, tunnels, swings, or other objects that increase opportunities for the expression of species-typical postures and activities and enhance the animals' well-being. Much has been learned in recent years about the natural history and environmental needs of many animals, but continuing research into those environments that enhance the well-being of research animals is encouraged. Selected publications that describe enrichment strategies for common laboratory animal species are listed in Appendix A and in bibliographies prepared by the Animal Welfare Information Center (AWIC 1992; NRC In press).

Social Environment

Consideration should be given to an animal's social needs. The social environment usually involves physical contact and communication among members of the same species (conspecifics), although it can include noncontact communication among individuals through visual, auditory, and olfactory signals. When it is appropriate and compatible with the protocol, social animals should be housed in physical contact with conspecifics. For example, grouping of social primates or canids is often beneficial to them if groups comprise compatible individuals. Appropriate social interactions

among conspecifics are essential for normal development in many species. A social companion might buffer the effects of a stressful situation (Gust and others 1994), reduce behavioral abnormality (Reinhardt and others 1988, 1989), increase opportunities for exercise (Whary and others 1993), and expand species-typical behavior and cognitive stimulation. Such factors as population density, ability to disperse, initial familiarity among animals, and social rank should be evaluated when animals are being grouped (Borer and others 1988; Diamond and others 1987; Drickamer 1977; Harvey and Chevins 1987; Ortiz and others 1985; Vandenbergh 1986, 1989). In selecting a suitable social environment, attention should be given to whether the animals are naturally territorial or communal and whether they should be housed singly, in pairs, or in groups. An understanding of species-typical natural social behavior will facilitate successful social housing.

However, not all members of a social species can or should be maintained socially; experimental, health, and behavioral reasons might preclude a successful outcome of this kind of housing. Social housing can increase the likelihood of animal wounds due to fighting (Bayne and others 1995), increase susceptibility to such metabolic disorders as atherosclerosis (Kaplan and others 1982), and alter behavior and physiologic functions (Bernstein 1964; Bernstein and others 1974a,b). In addition, differences between sexes in compatibility have been observed in various species (Crockett and others 1994; Grant and Macintosh 1963; Vandenbergh 1971; vom Saal 1984). These risks of social housing are greatly reduced if the animals are socially compatible and the social unit is stable.

It is desirable that social animals be housed in groups; however, when they must be housed alone, other forms of enrichment should be provided to compensate for the absence of other animals, such as safe and positive interaction with the care staff and enrichment of the structural environment. (Chapter 2, pages 36-38)

Organizations and Websites

American Zoo and Aquarium Association Enrichment Website http://www.enrich.org/aazk

The purpose of the Committee is "to provide animal caregivers the means in which to enrich, stimulate, and challenge the lives of the animals in their care." The committee augment's the "Enrichment Options" column in the *Animal Keepers' Forum* and in *The Shape of Enrichment* newsletter to provide a means for communicating ideas, techniques and information about enrichment. The site includes definitions, health and safety issues, printed resources, the enrichment video library, a database of ideas, and links.

American Zoo and Aquarium Association http://www.aza.org
8403 Colesville Rd., Suite 710
Silver Spring, MD 20910-3314
U.S.A.
Tel: (301) 562-0777, Fax: (301) 562-0888

AZA Office of Conservation and Science coordinates Taxon Advisory Groups (TAG) which monitor the status of particular species in captivity and provides recommendations on species management and care in captivity and with respect to conservation efforts. Primate TAGs include gibbons, great apes, New World monkeys, Old World monkeys, and prosimians. Committees, such as the Behavior and Husbandry Advisory Committee, specialize in broad scientific areas are coordinated to serve in advisory capacities for TAGs. Services include professional expertise and, in some cases, newsletters. The association holds regional and annual conferences at which environmental enrichment at zoos is often discussed. Services are geared towards member institutions, but anyone may contact members of these groups for information. There are fees for AZA membership, published membership directories, reports, and conference proceedings.

American Society of Primatologists http://www.asp.org/ASP/default.html
Steven J. Schapiro, Treasurer, ASP
Dept. of Veterinary Sciences
Univ. of Texas, M.D. Anderson Cancer Ctr.
Rt. 2, Box 151-B1
Bastrop, TX 78502-9733
U.S.A.
Tel: (512) 321-3991, Email: an83000@mdacc.mda.uth.tmc.edu

The American Society of Primatologists is an educational and scientific organization, whose purpose is to promote and encourage the discovery and exchange of information regarding primates, including all aspects of their anatomy, behavior, development, ecology, evolution, genetics, nutrition, physiology, reproduction, systematics, conservation, husbandry, and use in biomedical research. The society publishes the *American Journal of Primatology*, a quarterly bulletin for members, and the book *Primate Conservation: The Role of Zoological Parks* (J. Wallis, ed., 1997).

Animal and Plant Health Inspection Service, Office of Animal Care (APHIS/AC)
http://www.aphis.usda.gov/reac/
4700 River Rd., Unit 85
Riverdale, MD 20737-1234
Tel: (301) 734-5240, Fax: (301) 734-4978, Email: ace@aphis.usda.gov

The U.S. Department of Agriculture office that enforces the Animal Welfare Act and develops regulations for animal care by exhibitors, researchers, and animal dealers. Answers questions regarding the regulations including those about psychological wellbeing of nonhuman primates. Staff will also refer patrons to regional offices where they can communicate directly with Animal Care inspectors and veterinary medical officers. Provides free newsletter about APHIS/AC activities and legislative updates.

Animal Welfare Information Center http://www.nal.usda.gov/awic
National Agricultural Library
10301 Baltimore Ave.
Beltsville, MD 20705
U.S.A.
Tel: (301) 504-6212, Fax: (301) 504-7125, Email: awic@nal.usda.gov

A U.S. Department of Agriculture, Agricultural Research Service information provider that assists researchers, educators, and exhibitors who must comply with the Animal Welfare Act. Provides reference and referrel services including multidatabase literature searches, publishes animal care and use resource guides, bibliographies, and *Animal Welfare Information Center Bulletin*, and offers the workshop "Meeting the Information Requirements of the Animal Welfare Act". Some publications include sections or articles relevant to environmental enrichment for nonhuman primates. All services are free except for extended online literature searches.

Animal Welfare Institute, Lab Animal Section http://www.animalwelfare.com/Lab_animals/
Animal Welfare Institute
PO Box 3650
Washington, DC 20007
U.S.A.
Tel: (202) 337-2332, Fax: (202) 338-9478, Email: awi@animalwelfare.com

Contains full-text articles about primate cage space, lighting, manipulanda, and social housing largely written by primatologist Viktor Reinhardt. Also contains *Environmental Enhancement for Caged Rhesus Macaques: A Photographic Documentation.* A highlight of this site is *Environmental Enrichment for Nonhuman Primates: An Annotated Bibliography for Animal Care Personnel* by Viktor and Annie Reinhardt and David Seelig. The second edition (1998) bibliography is available in hardcopy and the electronic version contains contains over two hundred citations grouped as guidelines and regulations, enrichment programs (by species), inanimate enrichment, feeding enrichment, substrates, and animate enrichment. Some of the citations are linked to the full-text article. The focus of the bibliography is practical articles useful to animal care staff. On the web, the powerful database contains over 1200 annotated entries. It includes theoretical, philosophical,

practical, and more technical scientific citations from journal articles, books, and chapters. It also includes photographs and other audiovisual materials. Over 10 percent of the citations are linked to the full-text article. The database is regularly updated and is easily searched by the search engine on its home page. The "Special Features" button lists search topics and suggests keywords.

The Association of British Wild Animal Keepers http://www.wwwebspace.co.uk/~abwak

ABWAK is a non-profit organization specializing in improving cooperation among wild animal keepers. The site has links to information about the journal *Ratel*, animal diets, husbandry, grants, symposia, and enrichment. The enivornmental enrichment page includes practical ideas for enrichment provided and tested by members. http://www.wwwebspace.co.uk/~abwak/enrich.htm

Australian and New Zealand Council for the Care of Animals in Research and Teaching, Limited (ANZCCART)

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New Zealand Tel: 64-4-472 7421, Fax: 64-4-473 1841, Email: anzccart@rsnz.govt.nz, http://anzccart.rsnz.govt.nz

Through its varied activities ANZCCART seeks to promote effective communication and cooperation between all those concerned with the care and use of animals in research and teaching. It publishes a quarterly newsletter and other publications on euthanasia, animal care and use committees, humane care and use of animals in research, pain. Articles sometimes address environmental enrichment issues. The newsletter is free of charge.

Canadian Council on Animal Care (CCAC) http://www.ccac.ca/
315-350 Albert Street
Ottawa ON K1R 1B1
Canada
Tel: 613-238-4031, Fax: 613-238-2837, Email: ggriffin@bart.ccac.ca

Establishes and enforces standards and guidelines (in Canada) concerning the use of animals in research, testing and teaching. Maintains active, expert committees on all aspects of animal care and use. The Council's program is based on its major publication "Guide to the Care and Use of Experimental Animals," Volume 1, 2nd Edition (1993) and Volume 2 (1984). Both documents address environmental enrichment. CCAC conducts workshops and training courses on various aspects of the care and use of experimental animals, as well as the training of personnel working with these animals. Semi-annually publishes the newsletter, *Resource*.

Environmental Enhancement for Caged Rhesus Macaques: A Photographic Documentation
http://www.primate.wisc.edu/pin/pef/slide/intro.html

A walk-through electronic slideshow developed by Viktor Reinhardt and David Seelig containing 60 photographs of enrichment techniques for laboratory rhesus macaques. Sections are divided into Animate Environmental Enrichment and Inanimate Environmental Enrichment.

European Primate Resources Network http://www.dpz.gwdg.de:80/eupren/eupren.htm

EUPREN is an intiative of European institutes that perform research on nonhuman primates. The objectives of EUPREN are to ensure ethical and controlled use of primates, to secure availablity of high quality primates for research, and to establish an information network for those interested or working in research. The website contains bylaws; a census of primates in Europe and North Africa; abstracts from meetings on remote monitoring, housing, husbandry, and wellbeing, and marmoset and tamarin research; and a discussion paper on cage sizes for primates.

International Directory of Primatology http://www.primate.wisc.edu/pin/idp
Larry Jacobsen, Head of Library Services
Primate Center Library
Wisconsin Regional Primate Research Center
Madison, WI 53715-1299
U.S.A.
Tel: (608) 263-3512, Fax: (608) 263-4031, Email: jacobsen@primate.wisc.edu

A 400-page directory of the field of primatology includes detailed information about organizations, field studies, population management, people active in primatology, and information resources. Online version is searchable and available at the above website. Hardcopy ordering information may be obtained from Larry Jacobsen via e-mail at: jacobsen@primate.wisc.edu

Institute of Laboratory Animal Resources http://www2.nas.edu/ilarhome
2101 Constitution Avenue, NW
Washington, DC 20418
U.S.A.
Tel: (202) 334-2590, Fax: (202) 334-1687, Email: ILAR@nas.edu

ILAR is a division of the Commission on Life Sciences, National Research Council, National Academy of Sciences. It develops guidelines and disseminates information on the scientific, technological, and ethical use of animals and related biological resources in research, testing, and education. ILAR promotes high-quality, humane care of animals and the appropriate use of animals and alternatives. ILAR functions within the mission of the National Academy of Sciences as an advisor to the federal government, the biomedical research community, and the public. ILAR spearheaded the committee which produced the 1998 book **The Psychological Well-being of Nonhuman Primates**. The book is available online at
http://www.nap.edu/readingroom/reader.cgi?auth=free&label=ul.book.0309052335

ILAR also has a laboratory animal database including a list of nonhuman primate species and suppliers at http://www2.nas.edu/amgs/nhp.html

International Primatological Society (IPS) http://www.primate.wisc.edu/pin/ips.html
Psychology Department
University of Georgia
Athens, GA 30602
U.S.A.
Tel: (706) 542-3036, Fax: (706) 542-3275, Email: nishida@jinrui.zool.kyoto-u.ac.jp
Dr. D.M. Fragaszy, Sec.Gen. (Through 2000)

Individuals interested in primate research. Facilitates cooperation among primatologists and fosters conservation and judicious use of primates in research. Environmental enrichment issues are addressed by the Captive Care and Breeding Committee. IPS operates a small grants program for education and enrichment studies that have broad implications. The grant program is open to all applicants. Publishes biannual newsletter. The contact for captive care issues is Hilary Box, Ph.D., Dept. of Psychology, University of Reading, White Knights, Reading AOM RG6, United Kingdom, FAX: 44 1734 314 404.

Laboratory Primate Newsletter http://www.brown.edu/Research/Primate
Box 1853, Brown University
Providence, RI 02912
U.S.A.
Tel: (401) 863-2048, Fax: (401) 863-1300, Email: primate@brownvm.brown.edu

The quarterly newsletter provides information of interest to people involved in nonhuman primate research. *Directory of Graduate Programs in Primatology and Primate Research* is issued periodically. The newsletter is available by Email. To subscribe, send the message: Subscribe LPN-L your-own-name to listserv@brownvm. The website contains all issues of *Laboratory Primate Newsletter*, policies, graduate programs, and related links. The site also contains a very useful environmental enrichment section:

Articles on Environmental Enrichment and Psychological Well-being
http://www.brown.edu/Research/Primate/enrich.htm
Contains all articles on enrvironmental enrichment and psychological well-being that were printed in the newsletter from 1984-1998 (vols. 23-37). The site topics are social enrichment, environmental enrichment, training, physiological and other measures of stress and psychological well-being, rearing and social development, colony management, editorials, and information resources. Articles are available full text and free of charge.

Office for Protection from Research Risks (OPRR)
http://www.nih.gov/grants/oprr/library_animal.htm
National Institutes of Health Office of Extramural Research
OPRR, Division of Animal Welfare
6100 Executive Blvd., Suite B01
Rockville, MD 20892-7507
U.S.A.
Tel: (301) 496-7163, Fax: (301) 402-2803, Email: oprr@od.nih.gov

Enforces the *PHS Policy on Humane Care and Use of Laboratory Animals* for researchers who receive Public Health Service funding. Produces conferences and workshops relating to responsible animal care and use in biomedical research. Can provide guidance on the development of plans to enhance psychological well-being of nonhuman primates. The PHS Policy requires adherence to the Animal Welfare Act regulations and the *Guide for the Care and Use of Laboratory Animals*.

Primate Information Center http://healthlinks.washington.edu/pic/
1101 Westlake Ave. North
Seattle, WA 98109
U.S.A.
Tel: (206) 543-5531, Fax: (206) 616-1540, Email: pic@u.washington.edu

Provides fee-based bibliographic information to anyone interested in any nonhuman primate research topic. Produces the bibliographic journal *Current Primate References* and topical bibliographies. Maintains the **Primates Database** which has over 80,000 citations from 1985-present and works only on PC computers.

Primate Info Net http://www.primate.wisc.edu/pin/
Larry Jacobsen, Head of Library Services
Primate Center Library
Wisconsin Regional Primate Research Center
Madison, WI 53715-1299
U.S.A.
Tel: (608) 263-3512, Fax: (608) 263-4031, Email: jacobsen@primate.wisc.edu

A comprehensive website relating to all aspects of primatology. Includes information services, organizations and programs, information resources, products and services for primates, and related sites. There is a searchable database of primatologists from the *World Directory of Primatologists* and a listing of audiovisuals at the Primate Research Center. Audiovisuals are available on loan. The site also contains job information, meeting lists, news, images, and access to *Ask Primate*. *Ask Primate* is a reference service offered by the center that allows patrons to email questions relating to primate subjects. Due to the volume of questions, it is recommended that patrons explore local resources and libraries before consulting *Ask Primate*.

Primate Products and Services http://www.primate.wisc.edu/pin/prodser.html
Primate Products and Services
Larry Jacobsen, PIN Coordinator
Wisconsin Regional Primate Research Center
University of Wisconsin, Madison
1220 Capitol Court
Madison, WI 53715-1299
U.S.A.
Tel: (608) 263-3512, Fax: (608) 263-4031, Email: jacobsen@primate.wisc.edu

A directory of companies that support of Primate Info Net and other Internet-based services of the Wisconsin Regional Primate Research Center Library and Information Service. These services provide for communication, referral, and access to information about nonhuman primates for primatologists worldwide. Listings include a brief description of each company's products or services, e-mail address and a link to the company Web page.

Primate Society of Great Britain http://www.ana.ed.ac.uk/PSGB/
Thomas Sambrook,
Department of Psychology,
University of Stirling,
Stirling FK9 4LA,
U.K.
Tel: (0)1786-467679, Fax: UK (0)1786-467641, Email: tds1@stir.ac.uk

PSGB is a membership organization affiliated with the International Primatological Society. It has a Conservation Working Party and Captive Care Working Party to provide advice and coordinate action. Sponsors annual meeting. Publishes triennial *Primate Eye*.

Primate Supply Information Clearinghouse http://www.rprc.washington.edu/psic.htm
Washington Regional Primate Research Center
Box 357330
University of Washington
Seattle, WA 98195-7330
U.S.A.
Tel: (206) 543-5178, Fax: (206) 616-1710, Email: psic@bart.rprc.washington.edu

The PSIC provides communication between research institutions to facilitate exchanges of non-human primates or their tissues. The goal of the PSIC is to increase sharing of these animals, thereby decreasing the need to import animals for research, and to ultimately decrease the number of animals needed. The PSIC maintains a database of information about programs, sources, services, available/wanted animals, tissues, and primate equipment. Services are NOT available to private pet owners, commercial breeders, dealers, brokers, importer-exporters, pet trade animal suppliers, exhibitors, or those using non-human primates for commercial or entertainment purposes. The PSIC publishes two bulletins that serve as a reference and resource guides.

Scientists Center for Animal Welfare (SCAW) http://www.erols.com/scaw/
Golden Triangle Building One
7833 Walker Drive, Suite 340
Greenbelt, MD 20770
U.S.A.
Tel: (301) 345-3500, Fax: (301) 345-3503, Email: scaw@erols.com

Professional, non-profit organization that sponsors conferences addressing contemporary animal care and use issues in research. Publishes conference proceedings, training manuals, newsletters. Publications include *Well-Being of Nonhuman Primates in Research* and other SCAW-sponsored conference proceedings. Anyone may request membership, attend conferences, or purchase publications.

Universities Federation for Animal Welfare http://www.ufaw3.dircon.co.uk
The Old School
Brewhouse Hill
Wheathampstead, Hertfordshire
AL4 8AN
U.K.
Tel: +44 (0)1582 831818, Fax: +44 (0)1582 831414, E-mail: ufaw@ufaw.org.uk

UFAW is a scientific and technical animal welfare organization. It uses scientific knowledge and established expertise to improve the welfare of animals as pets, in zoos, laboratories, on farms and in the wild. UFAW does not campaign but funds research, holds symposia, gives advice to Government and others and produces publications on animal welfare.

Primate Centers and Animal Colonies

The Regional Primate Research Center (RPRC) facilities and resources are shared by RPRC staff scientists and investigators from other institutions across the country. The centers' specialized resources are intended to assist investigators who receive their primary research funding from NIH, but the centers may also host investigators who are funded by other federal, state, and local agencies, as well as by research foundations and the private sector. There are over 19,000 animals representing over 30 different species of nonhuman primates, mostly macaques, at these RPRCs.

Each RPRC has a Visiting Scientist Program that allows advanced training and research in nonhuman primate biology. Collaborative arrangements between investigators and center scientific staff are encouraged and can be developed on studies related to major human diseases, subject to the availability of resources and center staff time. Nonhuman primate blood samples, organs, and biological fluids are available through the RPRCs.

California Regional Primate Research Center http://www.primate.ucdavis.edu/crprc/
University of California, Davis
Davis, CA 95616
U.S.A.
Tel: (530) 752-0420, Fax: (530) 752-8201, Email: aghendrickx@ucdavis.edu

Research emphasizes the effects of environmental influences on human health and basic biological approaches. Resources provided include medicine, pathology and clinical laboratory services, electron microscopy, inhalation toxicology chambers, colony database, animals from breeding and research colonies, research facilities and pathalogical specimens for collaborators.

Caribbean Primate Research Center Program No URL available.
University of Puerto Rico
Medical Sciences Campus
P.O. Box 1053
Sabana Seca, PR 00952-1053
Tel: (809) 784-6619, Fax: (809) 795-6700, Email: 74232.203@compuserve.com

Collaborating scientists are encouraged to use the animal and osteological resources. Research objectives vary by site:

Cayo Santiago studies focus on social and sexual behavior, population genetics, demography, reproductive biology, functional morphological and spontaneous diseases (arthritis, osteoporosis, adult-onset macular degeneration, glaucoma, diabetes, obesity, hypertension), and parasitoses of rhesus monkeys maintained under seminatural conditions.

CRC headquarters are located at **Sabana Seca** where studies include biomedical research on spontaneous diseases, reproductive biology, social behavior, genetics, and husbandry of Cayo Santiago-derived rhesus macaques maintained under a variety of housing configurations (individual cages, pens, enclosures, and 1- to 2-acre corrals).

The **CPRC Museum** supports anthropological and biomedical osteological research on 2,500 complete skeletons from 10 species of nonhuman primates, including more than 1,000 from Cayo Santiago rhesus monkeys of known identity, age, sex, matriline, and parity, and 175 skeletons from patas monkeys.

Sierra Bermeja Field Study Site supports research on the ecology, behavior, and biology of introduced population of unprovisioned, free-ranging patas (*Erythrocebus patas*) in southwestern Puerto Rico.

Genetics Laboratory for Typing Nonhuman Primates http://www.trinity.edu/~wstone/index.htm
Trinity University
715 Stadium Dr.
San Antonio, TX 78212-7200
U.S.A.
Tel: (210) 736-8216, Fax: (210) 736-7229, Email: Wstone@Trinity.edu

Serves as a research resource for genetic typing of nonhuman primates. Laboratory can provide genetic profiles consisting of 10-15 DNA markers distributed randomly over all 21 rhesus chromosomes.

New England Regional Primate Research Center No URL available.
One Pine Hill Dr.
PO Box 9102
Southborough, MA 01772
U.S.A.
Tel: (508) 524-8002, Fax: (508) 460-0612, Email: jwortham@warren.med.harvard.edu

Research emphasis is on infectious diseases, immunology, ocological herpesviruses, pathology, behavioral biology, and cardiovascular disease. Provides tissues and other specimens for approved research projects as well as animals from breeding colonies.

Oregon Regional Primate Research Center http://www.teleport.com/~orprc
505 N.W. 185th Ave.
Beaverton, OR 97006
U.S.A.
Tel: (503) 645-1141, Fax: (503) 690-5569, Email: smithsu@ohsu.edu

Research emphasis is on reproductive sciences, neurosciences, pathobiology, and immunology. Provides tissues and other specimens, collaboration with other scientists, medical services, colony operation, pathology services, microscopy and image analysis services, data processing, Edocrine Services Laboratory, medical illustrations and photography, cell culture lines, DNA synthesis and sequencing, tissue embedding and sectioning, and animals from breeding colonies.
The library provides collaborating scientists with database searching services and internet access.

Squirrel Monkey Breeding and Research Resource http://southmed.usouthal.edu/com/primate
Primate Research Laboratory
College of Medicine
University of South Alabama
Mobile, AL 36688
Tel: (334) 460-6238, Fax: (334) 460-7783, Email: cabee@jaguar1.usouthal.edu

Research emphasis is to carry out multidisciplinary studies of reproduction in captive Bolivian squirrel monkeys and to provide a resource of laboratory born and reared animals for NIH-sponsored research programs. Outside investigators may request tissue or body fluid specimens. Collaborating investigators are provided animal husbandry, medical care, pathology services, and colony animals.

Tulane Regional Primate Research Center No URL available.
18703 Three Rivers Rd.
Covingoton, LA 70433
U.S.A.
Tel: (504) 892-2040, ext. 201, Fax: (504) 893-1352, Email: gerone@tpc.tulane.edu

Specializes in research in microbiology, parasitology, urology, gene therapy, and behavior. Provides laparoscopy, ultrasound, and specimens. Collaborating scientists receive animal care, pathology services, parasitology services, science information services, medical illustration services, and animals.

Washington Regional Primate Research Center No URL available.
I-421 Health Sciences
Box 357330
Seattle, WA 98195-7330
U.S.A.
Tel: (206) 685-0305, Fax: (206) 685-0305, Email: pattir@bart.rprc.washington.edu

Research emphasis is on neurological sciences, cardiovascular function, disease models, developmental biology, endocrinology and metabolism, AIDS, immunogenetics, and virology. Resources for outside investigators include a computer database of more than 80,000 bibliographic records (1985 to the present) of scientific literature on nonhuman primates which is available for lease on PC-compatible computer. This database includes full citation and indexing information. The **Primate Information Center** develops indexes of comprehensive, worldwide bibliographic information regarding biomedical research on nonhuman primates. PIC provides published and custom bibliographies. **Primate Supply Information Clearinghouse** provides communication links, by telephone and through semimonthly publication of the *New Listings Bulletin*, between U.S. scientists in need of primates or tissues and institutions that can meet their needs. A registry of primate colonies and special services is being developed. Investigators may also request tissues. Services to collaborating scientists include pathology, scientific illustration and editing, neurohistology, immunologic typing, primate colony care, biostructure technology laboratory, bioengineering, collections of records and slides, and animals. Also available on the website is *Template Atlas of the Primate Brain*.

Wisconsin Regional Primate Research Center http://www.primate.wisc.edu
University of Wisconsin-Madison
Graduate School
1220 Capitol Court
Madison, WI 53715-1299
U.S.A.
Tel: (608) 263-4031, Fax: (608) 263-4031

Research emphasizes reproduction and development, neurobiology, physiological ethology, psychobiology, aging and metabolic disease, and immunology and virology. Outside investigators may request biological materials. Collaborating scientists receive many bioservices, computer services, and animals.

The **library** is available to the public and is used for computerized database searches; document delivery; and contains 6,000 books; 10,000 volumes of journals; 300 active journal sub-scriptions; and 7,000 slides, videotapes, and other audiovisual materials. This is a major international resource. Other library services include:

PRIMATE-TALK: An electronic discussion forum for professionals in primatology. Further information is available at: http://www.primate.wisc.edu/pin/ptalk.html;
Email: primate-talk-admin@primate.wisc.edu.

PRIMATE INFO NET (PIN): An information resource providing access to documents and links to WWW sites about research, conservation, and education in the field of primatology. URL: http://www.primate.wisc.edu/pin/. Telnet: wiscinfo.wisc.edu and look for link to Primate Info Net via Primate Center Library.

ASKPRIMATE: A cooperative Internet reference service available to the public. To ask a question or for referral, send e-mail to: askprimate@primate.wisc.edu.

PRIMATE-JOBS: A job listing service on the World Wide Web. Includes paid and volunteer positions wanted and available. Connect to PRIMATE-JOBS at:
http://www.primate.wisc.edu/pin/jobs.

Audiovisual Services: An archival collection of primate-related videotapes, slides, and audiotapes may be borrowed for research or education. A catalog is at:
http://www.primate.wisc.edu/pin/av.html. For more information, contact Ray Hamel, Special Collections Librarian, via e-mail at: hamel@primate.wisc.edu.

International Directory of Primatology: A 400-page directory of the field of primatology includes detailed information about organizations, people, species held, educational programs, primates in zoos, information resources. Online version is available at
http://www.primate.wisc.edu/pin/idp Hardcopy ordering information may be obtained from Larry Jacobsen via e-mail at: jacobsen@primate.wisc.edu

World Directory of Primatologists. A list of over 1,600 people in the field of primatology with contact and email information. Available from http://www.primate.wisc.edu/pin/wdp.html

Yerkes Regional Primate Research Center http://www.cc.emory.edu/YERKES/
Emory University
Atlanta, GA 30322
U.S.A.
Tel: (404) 727-7707, Fax: (404) 727-0623, Email: insel@rmy.emory.edu

Research emphasis is on bomedical and biobehavioral research to improve the health and well-being of human and nonhuman primates. Animals, veterinary medicine, pathology, and biomedical engineering are provided to investigators.

Listservs

Alloprimate Moderated general primatology site managed by Schrier Research Laboratory personnel, publishers of *Laboratory Primate Newsletter*. Join by sending a blank email message to *alloprimate-subscribe@egroups.com*

Calli-Talk For people interested in marmosets and tamarins. Sponsored by the European Marmoset Research Group. Subscribe by sending the message "subscribe calli-talk <your email address>" to *listproc@gwdg.de*

Primate Enrichment Forum-List Focuses on environmental enrichment topics, stress, well-being, husbandry, and other primate issues. To be added to the list, contact David Seelig at *david.seelig@yale.edu*

Primate-Science Managed by Larry Jacobsen of the Wisconsin Regional Primate Research Center. The purpose of this forum is the factual, science-based exchange of ideas and information about nonhuman primates and isintended to serve the international primatological research community. Application for membership is available at the website http://www.primate.wisc.edu/pin/ps/pscientry.html or by email at: *primate-science-request@primate.wisc.edu* In the message area, type: *subscribe primate-science*

PRIMATE-TALK An international electronic discussion forum for professionals in primatology. Covers news, veterinary issues, animal care, and research discussions. The site is managed by the Wisconsin Regional Primate Research Center. Further information is available at: http://www.primate.wisc.edu/pin/ptalk.html To subscribe, send email to *primate-talk-request@primate.wisc.edu* and include, in the body of the message: *subscribe primate talk*

Suppliers and Products

Bio-Serv http://www.bio-serv.com/primain.html
One 8th St., Suite 1
Frenchtown, NJ 08825
U.S.A.
Tel: (908) 996-2155, Fax: 908-996-4123, Email: Veterinary Assistance: vetserv@bio-serv.com, Technical Assistance: techserv@bio-serv.com, Sales Assistance: sales@bio-serv.com

Maker or distributor of food treats, foraging and grooming boards, toys, and mirrors for nonhuman primates.

Nylabone Products
Third Avenue and Union St.
Neptune, NJ 07753
U.S.A.
Tel: (908) 988-8400
Manufacturer of Nylabone, Nylaballs, Gumabone Plaque Attacker, Gumabone tugs, and Gumadisc Flying Disc chew toys for dogs and other animals.

Primate Products http://primateproducts.com
1755 East Bayshore Rd., Suite 28A
Redwood City, CA 94063
U.S.A.
Tel: (650) 368-0663, Fax: (650) 368-0665, Email: sales@primateproducts.com

Produces and distributes autoclavable enrichment devices for outdoor and indoor use. Devices include mirrors, puzzle toss, swings, puzzle feeders, foraging feeder, Prima-hedron and Prima-hut outdoor structures,"Kong Toys", swings, and food treats. Also sells the Activity Monitor System which is a microprocessor inside the Puzzle-Toss that records the date and time every time the animal picks up or drops the ball. After the ball is removed from the cage, the monitor is connected to a PC-compatible computer through a standard serial port to download the data stored in the activity monitor in the form of an ASCII file. You can use the data to reveal the animal's preference to color, taste, texture, smell, etc.

Audiovisuals

Audiovisuals available for loan from the Primate Information Center are marked with *PIC call number*. National Agricultural Library videos have *NAL call number.*

Audiovisual Archives http://www.primate.wisc.edu/pin/askprim.html
Lists slides and videotapes related to nonhuman primates that are available from the Primate Information Center at University of Wisconsin-Madison. For more information, contact Ray Hamel, Special Collections Librarian, via e-mail at: hamel@primate.wisc.edu

Benevolent Primate Husbandry (1990). Produced by Ross Barker, Oregon Regional Primate Research Center.
PIC call number: VT0329
This program is designed to give caretakers an understanding of primate behaviors and develop a kind and respectful philosophy of care. Macaque behaviors shown include social interactions (grooming, play, aggression) and methods of communication (facial expressions such as open mouth threat, closed mouth threat, fear grin and lipsmacking). Also shown are a variety of examples of abnormal behavior developed when animals become stressful that caretakers should learn to identify. VHS, 25 min.

Environmental Enrichment: Advancing Animal Care (1990). Produced by Countrywise Communication. Distributed by Universities Federation for Animal Welfare.
NAL call number: Videocassette no. 1327
PIC call number: VT0273
This videotape (presented in three titled sections) is designed to provide instruction and promote discussion of environmental enrichment procedures for animals in zoos, laboratories, farms, and pets. Common marmosets are shown in a specific example in which they are provided with hidden food to encourage foraging behavior in order to reduce cage circling behavior. VHS, 37 min.

Environmental Enrichment Devices and Procedures for Captive Non-human Primates (1989). Produced by Lyna Watson, Primate Ethology Unit, New England Regional Primate Research Center.
PIC call number: VT0117
Describes and demonstrates the environmental enrichment devices and procedures for singly housed and group-housed species of macaques and New World monkeys at the New England Regional Primate Research Center. Some of the devices shown include hanging feeders, puzzle feeders, and PVC pipes. Procedures include the training of animals for blood sample collection for insulin readings. VHS, 30 min.

Environmental Enrichment For Individually Caged Rhesus Macaques (1988). Photography by Bob Dodsworth and Viktor Reinhardt, Wisconsin Regional Primate Research Center.
PIC call number: SS034
Environment enrichment for caged rhesus macaques is shown through the introduction of branches or

compatible companions. 78 slides.

Granby's Primates: A Captive Life (1983). Produced by Steve Holloway. Distributed by Filmakers Library.
PIC call number: VT0129
A study was conducted on 5 primate species at the Granby Zoo in Montreal to compare the behaviors of primates in the wild and in captivity, to provide for better environmental enrichment in zoo exhibit design. Species studies were the gorilla, chimpanzee, orangutan, ring-tailed lemur (Lemur catta), and white-handed gibbon. Some abnormal behaviors shown include aggression, stereotypic pacing, obesity, and smoking a cigarette. VHS, 28 min.

Metro Washington Park Zoo : Environmental Enrichment Program (1992). Metro Washington Park Zoo: Portland, OR
NAL call number: Videocassette no. 1532
This video shows how the Metro Washington Park Zoo introduces experiences to the animals that are functionally similar to those they would encounter in their natural habitat. 15 min.
Descriptors: zoo animals, behavior, environmental enrichment.

New Frontiers in Animal Behavior Management (1997). Produced and distributed by Gary Priest, San Diego Zoo, PO Box 551, San Diego, CA 92112
PIC call number: VT0619
Demonstration of several management techniques using positive reinforcement, on subjects ranging from siamangs to tigers to human teenagers. VHS, 35 min.

Nonhuman Primates: Environmental Enrichment (1992). Health Sciences Center for Educational Resources, University of Washington: Seattle, WA.
NAL call number: Slide No. 435
Covers psychological well-being by social, non-social, contact, and non-contact approaches. 61 slides, 25 min. audiocassette, guide.
Descriptors: laboratory animals, behavior, enrichment.

Primate Enrichment (1996?). Produced and distributed by Kelley Bollen, Burnet Park Zoo, Syracuse, NY 13204, Tel: 315-435-8512
PIC call number: VT0487
Primate enrichment at the Burnet Park Zoo through the use of food presentation devices and toys. Food presentation devices include plastic containers, PVC tubing, logs, puzzle boxes, cloth bags, milk crates, coconut feeders and frozen milk carton treats. Toys include burlap, cloth and paper bags; a boomer ball; a wicker basket and t-shirt; a cotton mop; and a burlap hammock. Species seen interacting with these objects include white-handed gibbons, ruffed lemurs, tamarins, vervets, mandrills, siamangs, ring-tailed lemurs, slow lorisess coucang), and bushbabies. VHS

Training Corral-Living Rhesus Monkeys for Fecal and Blood Sample Collection (1990). Produced by M. R. Clarke, K. M. Phillippi, J. A. Falkenstein, E. A. Moran, Tulane Regional Primate Research Center and S. J. Suomi, Laboratory Comparative Ethology, NICHD. Jeff Falkenstein Productions. Distributed by the Tulane Regional Primate Research Center.
PIC call number: VT0217
Shows the acclimation techniques employed to reduce stress for corral-living rhesus monkeys when collecting fecal and blood samples. The monkeys are given food rewards in return for defecation in single holding cages. They are also trained to extend their leg through a modified squeeze cage for unanesthetized bleeding from the saphenous vein. Once the acclimation is completed, the animals are shown to be relaxed during the procedure. One adult female continued to nurse her neonate infant through the venipuncture. This behavior modification is intended to reduce stress and increase safety for the animals and the technicians. VHS, 27 min. This tape also provides a look at the corral facility at the Tulane Regional Primate Research Center at Tulane University.

Training Medical Behaviors in Orang-utans at Brookfield Zoo (1989). Produced by the Brookfield Zoo, Chicago Zoological Society. Distributed by Ceil Wilson, Brookfield Zoo, 3300 Gold Road, Chicago, IL 60513
PIC call number: VT0299
Positive reinforcement is used to train diabetic orang utans to voluntarily submit a limb for venipucture. VHS, 10 min.

Journals and Newsletters

American Journal of Primatology http://www.interscience.wiley.com
John Wiley & Sons, Inc.
605 Third Ave.
New York, NY 10158
U.S.A.
Tel: (212) 850-6645
NAL call number: QL737 P9A5

Official journal of the American Society of Primatologists. Contains research papers on all primate-related subjects including wild and captive animal studies, conservation, and enriching the captive environment.

Animal Keepers' Forum http://aazk.epower.net
American Association of Zoo Keepers AAZK, Inc.
Administrative Offices
635 Gage Blvd.
Topeka, KS 66606-2066
U.S.A.
Tel./Fax: (785) 273-1980
NAL call number: QL77.5 A54

Monthly journal of the American Association of Zoo Keepers, Inc. (AAZK) contains a regular features such as "Enrichment Options" which highlights psychological stimulation, behavioral enrichment, activity manipulation, and occupational husbandry in zoo and aquarium environments. AAZK is the professional organization for zookeepers in America (primarily in the U.S.) and holds annual conferences, publishes proceedings, and sponsors special projects that improve animal care.

Animal Technology http://www.mandm.ncl.ac.uk/MandM/IAT/AnTech.html
Subsciptions, Mr. P.C. Smith
Post Code 826
Pfizer Central Research
Ramsgate Rd., Sandwich, Kent CT13 9NJ
U.K.
NAL call number: QL55 I5

A journal published three times a year by the Institute of Animal Technology. Routinely features short articles, technical notes, or reviews pertaining to enriched housing/caging options or enrichment strategies for various laboratory and farm animals including birds and other non-mammalian species.

Animal Welfare http://www.ufaw3.dircon.co.uk
Universities Federation for Animal Welfare
The Old School, Brewhouse Hill
Wheathampstead, Herts AL4 8AN
U.K.
Tel: 01582 831818, Fax: 01582 831414
NAL call number: HV4701 A557

Peer-reviewed quarterly journal that includes articles on scientific research and technical studies related to the welfare of animals kept on farms, in laboratories, as companions, in zoos, or managed in the wild. Includes many environmental enrichment articles and international technical reports.

Animal Welfare Information Center Bulletin http://www.nal.usda.gov/awic/newsletters/awicnews.htm
Animal Welfare Information Center
National Agricultural Library
10301 Baltimore Ave.
Beltsville, MD 20705
U.S.A.
Tel: (301) 504-6212, Fax: (301) 504-7125, Email: awic@nal.usda.gov

Published quarterly and contains animal care and use articles, regulatory updates, and grants information. Articles are geared to researchers, exhibitors, and educators who must comply with the Animal Welfare Act. Environmental enrichment articles are frequently featured. There is no fee for the subscription and all issues are posted on the website in full text.

Applied Animal Behaviour Science http://www.elsevier.com
Elsevier Science
P.O. Box 945
New York, NY 10159-0945
U.S.A.
Tel: (212) 633-3730, Fax: (212) 633-3680, Email: usinfo-f@elsevier.com
NAL call number: QL750 A6

Peer-reviewed journal that reports on applications of ethology of animals used by man. Emphasis is on farm species, but laboratory, zoo, and wildlife species are also covered. Features environmental enrichment research on nonhuman primates in zoo and laboratory contexts.

Folia Primatologica http://www.karger.com/journals/fpr/fprcdes.htm
S. Karger Publishers, Inc.
26 West Avon Rd.
P.O. Box 529
Farmington, CT 06085
U.S.A.
Tel: 1-800-828-5479, Fax: (860) 675-7302, Email: karger@karger.ch
NAL call number: QL737 P9F6

This bimonthly international primatology journal is the official journal of the European Federation for Primatological Research. Topic areas range from microbiology to paleontology. Includes articles on primate learning, social behavior, care and use, and environmental enrichment. Subscibers may view issues online from the website.

Journal of Applied Animal Welfare Science http://www.psyeta.org/jaaws/
Journal Subscription Department
Lawrence Erlbaum Associates, Inc.
10 Industrial Ave.
Mahwah, NJ 07430-2262
U.S.A.
Tel: (201) 236-9500, Fax: (201) 236-0072
NAL call number: HV5701 J68

Peer-reviewed quarterly journal that publishes articles and commentaries on methods of experimentation, husbandry, and care that enchance the welfare of animals. Website contains issue contents and abstracts as well as guidelines for authors.

Journal of Medical Primatology
Munksgaard International Publishers Ltd.
Commerce Place
350 Main St.
Malden, MA 02148-0518
U.S.A.
Tel: (781) 388-8273, Fax: (781) 388-8274, Email: fsub@mail.munksgaard.dk
NAL call number: QL737 P9J66

Publishes articles on primates as research models, veterinary medicine, husbandry and management in the laboratory, wildlife management, behavioral and social needs related to medical conditions and captive primate care.

International Zoo News: IZN
80 Cleveland Road
Chichester, West Sussex PO19 2HF
Great Britain
NAL call number: QL76 I58

Published eight times per year and is dedicated to exchanging news, information, and ideas between zoos of the world. Feature articles sometimes describe environmental enrichment techniques.

Lab Animal http://www.labanimal.com
Lab Animal Subscription Department
P.O. Box 5054
Brentwood, TN 37024-5054
Tel: 1-800-524-2688, Email: subscriptions@natureny.com
U.S.A.
NAL call number: QL55 A1L33

Published 11 times a year and emphasizes proper management and care of laboratory animals. Contains articles that discuss information, ideas, methods, and materials for animal reseach professionals. It routinely contains articles dealing with environmental enrichment techniques and occasionally devotes an issue to the topic. Last issue of the year is the next year's Lab Animals Buyers Guide which contains ordering information for laboratory animals, products such as enrichment devices, and services.

Laboratory Animals http://www.mandm.nc1.ac.uk/laban.html
Royal Society of Medicine Press, Ltd.
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London W1M 8AE
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NAL call number: QL55 A1L3

This quarterly journal is The International Journal of Laboratory Animal Science and Welfare and the official journal of severla organizations including the Laboratory Animal Science Association (LASA), Gesellschaft für Versuchstierkunde, Nederlandse Vereniging voor Proefdierkunde, Schweizerische Gesellschaft für Versuchstierkunde, and the Federation of European Laboratory Animal Science Associations. Contains occassional articles on environmental enrichment for nonhuman primates as well as articles on primate behavior and neurosciences. Publishes European and international working group reports and guidelines on animal care and use topics.

Laboratory Animal Science http://www.aalas.org/laonline.htm
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NAL call number: 410.9 P94

Bimonthly journal of the American Association for Laboratory Animal Science. Covers diseases, research applications, and the biology of animals used as models in research. Abstracts are available free from the website. Members can view entire issues on the Web.

Laboratory Primate Newsletter http://www.brown.edu/Research/Primate
Schrier Research Laboratory
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Tel: (401) 863-2511, Fax: (401) 863-1300, Email: primate@brownvm.brown.edu
NAL call number: SF407 P7L3

Quarterly publication geared towards researchers who study or use nonhuman primates. Includes conference papers, announcements, grants, research and education opportunities, employment opportunities, and recent books and articles listed by topic with abstract. Full text issues are available at the website.

Primate Report http://134.76.248.10/infra/primrep.htm
Dr. Dr. M. Schwibbe
German Primate Center (DPZ)
Kellnerweg 4
D-37077 Goettingen
Germany
NAL call number: QL737 P9P65

Publishes original papers, abstracts and contributions from the meetings of national and international primatological societies, from symposia as well as special issues like surveys on primatological activities in habitat countries and census of captive primates in the Old World countries. Papers come from any area of primatology, including breeding and husbandry, behavior, evolutionary biology, morphology, physiology and palaeontology.

Ratel http://www.wwwebspace.co.uk/~abwak/ratel.htm
The Association of British Wild Animal Keepers
Edinburgh Zoo
Corstophine Rd.
Edinburgh EH12 6TS
U.K.
Fax: +44 0131 354 6775, Email: abwak@wwwebspace.co.uk
NAL call number: QL77.5 R37

A bimonthly journal written by British animal keepers for animal keepers. Contains feature articles on animal welfare and husbandry, news and announcements, and the column *From Rags to Enrichment*. The website contains an enrichment button that lists and describes environmental enrichment methods designed by animal keepers.

The Shape of Enrichment http://enrichment.org
The Shape of Enrichment, Inc.
1650 Minden Dr.
San Diego, CA 92111-7124
Fax: (619) 279-4208, Email: shape@enrichment.org
NAL call number: HV4737 S53

Quarterly newsletter dedicated to exchanging enrichment ideas among animal caretakers. Also operates an enrichment and training video library.

Zoo Biology http://www.interscience.wiley.com
John Wiley & Sons, Inc.
605 Third Ave.
New York, NY 10158
U.S.A.
Tel: (212) 850-6645
NAL call number: QL77.5 Z6

Bimonthly journal published in association with the American Zoo and Aquarium Association. Contains scientific articles on all aspects of zoo biology including behavior, nutrition, veterinary medicine, and husbandry. Frequently publishes environmental enrichment studies.

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Articles

General Environmental Enrichment

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NAL call number: HV4737 S53
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General Primate Enrichment

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NAL call number: SF601 C66
Descriptors: behavior, wellbeing, caging, toys, social behavior, stereotypies, locomotion, visual stimuli.

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NAL call number: 410.9 P94
Although social housing is desirable for social species of nonhuman primates, circumstances arise whereby social housing is precluded (for example, certain kinds of infectious disease or toxicologic research, when the health of the animal(s) would be compromised by social housing, and animals which respond behaviorally in an inappropriate manner to social housing). Nonsocial alternatives that provide increased environmental complexity to the home cage should then be considered. Nonsocial "environmental enrichment" schemes can be designed to enhance the expression of an individually housed nonhuman primate's locomotive/postural, manipulative, and foraging behaviors. In this way,

nonsocial, but species-typical, behaviors can be promoted in the single cage housing condition.
Descriptors: housing, husbandry, enrichment, exceptions.

Bayne, K.A.L., S.L. Dexter, J.K. Hurst, G.M. Strange, and E.E. Hill (1993). **Kong toys for laboratory primates: Are they really an enrichment or just fomites?** *Laboratory Animal Science* 43(1): 78-85.
NAL call number: 410.9 P94
Simple toys as enrichment devices have been associated with a rapid decline in their use by nonhuman primates. Other facets of toy presentation have not been described previously. For example, a comparison of the effect(s) of an enrichment device between two facilities should be validated if enrichment recommendations are to be made that affect diverse research facilities across the country. Additionally, a comparison of two methods of presentation (one highly accessible to the animal and the other less accessible) of the same enrichment device for potential differences in efficacy could provide direction in implementing an enrichment program based on simple toys. The handling of enrichment devices by nonhuman primates can lead to the spread of microbial contamination. The typical enrichment program rotates enrichment devices among animals to maximize the variety of stimuli available to each primate in the most economic manner. An adequate sanitation program is therefore pivotal to minimizing the potential for enrichment devices to be fomites. We conducted three experiments that addressed these issues. The results confirmed that, alhtough the presence of a simple toy reduced behavioral pathology, there was variability in behavioral effect for an enrichment technique between facilities. Two methods of presentation (on floor and suspended) of a simple toy did not produce any significant differences in use. Finally, we demonstrated that microbial growth can persist on enrichment devices after they have been sanitized in a commercial cagewasher.
Descriptors: toys, sanitation versus environmental enrichment, microbial growth.

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NAL call number: QL55 H8
Descriptors: primates, laboratory, enrichment.

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NAL call number: 410.9 P94
Before implementing an environmental enrichment program for nonhuman primates, several issues should be considered. The assignment of enrichment tasks can be made to caretakers, a dedicated "enrichment technician," volunteers, students or individuals with training in behavioral science. Determining the enrichment techniques to be used must take into account personnel time available; the species, age, sex, and individual histories of the nonhuman primates; and experimental protocols for which animals are being maintained. Identifying the most beneficial way to use the available personnel time must be tailored for each institution. To meet federal regulations, records must be kept

of the environmental enhancements available to each nonhuman primate. Good record-keeping will allow appropriate evaluation of the program. This evaluation should involve the animals' responses to the enrichment opportunity, cost and durability of enrichment items, human and nonhuman safety considerations, and personnel required. The well-being of captive nonhuman primates will be most improved if well-informed decisions are made in developing and managing environmental enrichment programs.
Descriptors: record keeping, evaluation, enrichment plans.

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NAL call number: QL77.5 A54
Descriptors: Burnet Park Zoo, enrichment strategies.

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NAL call number: QL737 P9P74 1990
Descriptors: species differences, adaptation, nature, captivity, stress, distress, physiology.

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NAL call number: HV4737 S53
Descriptors: zoos, laboratories, foraging behavior.

Carlson, S., P. Rama, D. Artchakov, and I. Linnankoski (1997). **Effects of music and white noise on working memory performance in monkeys**. *Neuroreport* 8(13): 2853-56.
It has been suggested that Mozart's music may have beneficial effects on the performance of cognitive tasks in humans. In the present study the effects of Mozart's piano music, white noise, simple rhythm and silence were studied on the performance of a delayed response (DR) task in monkeys. The acoustic treatments were given for 15 min, either before or during DR testing. The acoustic treatments did not affect DR performance when given before testing. However, Mozart's piano music played during DR testing caused a significant deterioration in the performance of the monkeys, whereas white noise improved it. It is suggested that Morzart's music serves as distractive stimulation during DR performance thus affecting working-memory-related neuronal processing and performance. White background noise, on the other hand, may improve DR performance by protecting against environmental distraction during testing.
Descriptors: nervous system, sensory stimulus, music, memory, background noise.

Clardy, B.E., A.W. Grady, and W.M. Taylor (1997). **An economical enrichment device for nonhuman primates**. *Contemporary Topics in Laboratory Animal Science* 36(4): 71.
NAL call number: SF405.5 A23
Descriptors: costs of enrichment, laboratory primates, behavior.

Crockett, C.M. and D.M. Bowden (1994). **Challenging conventional wisdom for housing monkeys**. *Lab Animal* 23(2):29-33.
NAL call number: QL55 A1L33
Descriptors: laboratory primates, animal welfare, cage size.

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NAL call number: SF408 5435 1998
Descriptors: laboratory primates, psychological well-being, review.

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NAL call number: HV4737 S53
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Descriptors: manipulanda, novelty, zoos.

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NAL call number: SF405.5 C36
Descriptors: lab primates, enrichment, animal wellbeing.

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NAL call number: QL77.5 R37
Descriptors: waste paper, zoo primates.

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Descriptors: tunnel, social behavior, laboratory, exploratation.

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NAL call number: QL55 A1L3
Descriptors: foraging behavior, laboratory, activity level, behavioral changes.

Jacobsen, L., R. Hamel, and J. Brown (1998). **Internet resources in primatology.** *ILAR Journal* 38(4):171-184.
NAL call number: QL55 A1I43
Descriptors: audiovisuals, directories, websites, listservs, electronic resources.

Laule, G. (1994). **Use of positive reinforcement techniques in primates to enhance animal care, research, and enrichment**. *Canadian Association of Laboratory Animal Science Newsletter* 28(2): 33-36.
NAL call number: SF405.5 C36
Descriptors: animal training, rewards, conditioning, behavior, animal welfare.

Ludes, E. (1996). **Welfare and environmental enrichment of captive primates**. *STAL* 21(1): 25-39.
Descriptors: psychological wellbeing, species-specific behavior, laboratory and zoo primates.

Marriner, L.M. and L.C. Drickamer (1994). **Factors influencing stereotyped behavior of primates in a zoo**. *Zoo Biology* 13(3):267-275.
NAL call number: QL77.5 Z6
Descriptors: rearing methods, repetitive motor patterns, atypical behavior, lemurs, tamarins, macaques, spider monkeys, baboons, apes.

Marriott, B.M., R.W. Marriott, J. Norris, and D. Lee (1993). **A semi-natural habitat for housing small nonhuman primates.** *Journal of Medical Primatology* 22(6):348-354.
NAL call number: QL737 P9J66
Descriptors: cage complexity, laboratory, activity levels.

Maxwell, J. (1993). **Stimulating natural behavior: enrichment.** *Australian Primatology* 7(4):17-18.
Descriptors: zoos, measuring behavior, activity.

Maxwell, J. (1993). **Stimulating natural behaviors: enrichment for brains and hands**. *Shape of Enrichment* 2(1):1-2
NAL call number: HV4737 S53
Descriptors: zoos, primates, environmental enrichment.

Murchison, M.A. (1993). **Potential animal hazard with ring toys.** *Laboratory Primate Newsletter* 34(1):1-2.
NAL call number: SF407 P7L3
Descriptors: risks, choking, ring toys, devices.

Novak, M.A., A. Rulf, H. Munroe, K. Parks, C. Price, P. O'Neill, and S. J. Suomi (1995). **Using a standard to evaluate the effects of environmental enrichment**. *Lab Animal* 24(6): 37-42.
NAL call number: QL55 A1L33
Descriptors: laboratory primates, methods, assessing enrichment.

Reinhardt, V. (1993). **Enticing non-human primates to forage for their standard biscuit ration.** *Zoo Biology* 12:307-312.
NAL call number: QL77.5 Z6
Descriptors: foraging behavior, activity levels, novelty stimulus.

Reinhardt, V. and A. Reinhardt (1998). *Environmental Enrichment for Nonhuman Primates: An Annotated Bibliography for Animal Care Personnel.* 2nd ed. Animal Welfare Institute, PO Box 3650, Washington, DC 20007
Descriptors: guidelines and regulations, enrichment programs, inanimate enrichment, feeding enrichment, substrates, animate enrichment.

Reinhardt, V. and A. Reinhardt (1992). **Quantitatively tested environmental enrichment options for singly-caged nonhuman primates: A review**. *Humane Innovations and Alternatives* 6:374-383.
NAL call number: QL55 H8
Descriptors: animal welfare, assessing enrichment options.

Reinhardt, V. and A. Roberts (1997). **Effective feeding enrichment for non-human primates: A brief review**. *Animal Welfare* 6(3):265-272.
NAL call number: HV4701 A557
Descriptors: foraging, laboratories, feed processing, zoos, animal welfare.

Rosenblum, L.A. and M.W. Andrews (1995). **Environmental enrichment and psychological well-being of nonhuman primates.** In: *Nonhuman Primates in Biomedical Research, Biology, and Management,* B.T. Bennett, C.R. Abee, and R. Henrickson, eds., Academic Press: New York., pp. 101-112.
NAL call number: SF407 P7N66 1995
Descriptors: enrichment programs, behavior, devices, social groups.

Sambrook, T.D. and H.M. Buchanan-Smith (1997). **Control and complexity in novel object enrichment.** *Animal Welfare* 6(3): 207-216.
NAL call number: HV4701 A557
Descriptors: novelty, manipulanda, complexity, ecological approaches.

Sambrook, T.D. and H.M. Buchanan-Smith (1996). **What makes novel objects enriching? A comparison of the qualities of control and complexity.** *Laboratory Primate Newsletter* 35(4): 1-4.
NAL call number: SF407 P7L3
Descriptors: novelty, manipulanda, complexity.

Schnell, C. R. and P. Gerber (1997). **Training and monitoring of animals.** In *Abstracts of the Second EUPREN/EMRG Winter Workshop : The housing of non-human primates used for experimental and other scientific purposes: Issues for consideration, Rome 27.09.1996.* (Monograph online available from: http://www.dpz.gwdg.de:80/eupren/eupren.htm [January 1999]). European Primate Resources Network (EUPREN).
Descriptors: positive reinforcement, rewards, observations.

Sokol, K.A. (1993). **Commentary: thinking like a monkey--"primatomorphizing" an environmental enrichment program**. *Lab Animal* 22(5):40-45.

NAL call number: QL55 A1L33
Descriptors: laboratory, environmental enrichment.

Swanson, J., M.D. Kreger, D.J. Berry, J. Lyons-Carter, and J. Larson (1992). *Environmental enrichment information resources for nonhuman primates: 1987-1992.* National Agricultural Library, Animal Welfare Information Center: Beltsville, MD, 105p.
NAL call number: aZ7996.P85E58 1992
Descriptors: bibliography, information resources.

Taira, K., and E.T. Rolls (1996). **Receiving grooming as a reinforcer for the monkey.** *Physiology and Behavior* 59(6): 1189-1192.
NAL call number: QP1 P4
Descriptors: grooming, social contact, positive reinforcement.

Visalberghi, E. and J.R. Anderson (1993). **Reasons and risks associated with manipulating captive primates' social environments.** *Animal Welfare* 2(1): 3-15.
NAL call number: HV4701 A557
Descriptors: group housing, aggression, boredom, resource access.

Watts, E. and A. Meder (1996). **Introduction and socialization techniques for primates.** In: *Wild Mammals in Captivity Principles and Techniques*. D.G. Kleiman, M.E. Allen, K.V. Thompson, and S. Lumpkin, eds., University of Chicago Press:Chicago, pp. 67-77.
NAL call number: SF408 W55 1996
Descriptors: introductions, aggression, social behavior.

Weed J.L., Baker, S.C. Harbaugh, and J. Erwin (1995). **Innovative enclosures for laboratory primates: evaluation of a "breeding condominium".** *Lab Animal* 24(7): 28-32.
NAL call number: QL55 A1L33
Descriptors: housing, social interactions, laboratory.

Woolley, A.P.A.H. (1997). **Requirements of biomedical research in terms of housing and husbandry: pharmacology and toxicology.** In *Abstracts of the Second EUPREN/EMRG Winter Workshop : The housing of non-human primates used for experimental and other scientific purposes: Issues for consideration, Rome 27.09.1996.* (Monograph online available from: http://www.dpz.gwdg.de:80/eupren/eupren.htm [January 1999]). European Primate Resources Network (EUPREN).
Descriptors: social housing, isolation housing, experimental studies, husbandry.

Enrichment Plans

Bloomsmith, M.A., L.Y. Brent, and S.J. Schapiro. (1991). **Guidelines for developing and managing an environmental enrichment program for nonhuman primates.** *Laboratory Animal Science* 41(4):372-377.
NAL call number: 410.9 P94
Before implementing an environmental enrichment program for nonhuman primates, several issues should be considered. The assignment of enrichment tasks can be made to caretakers, a dedicated

"enrichment technician," volunteers, students or individuals with training in behavioral science. Determining the enrichment techniques to be used must take into account personnel time available; the species, age, sex, and individual histories of the nonhuman primates; and experimental protocols for which animals are being maintained. Identifying the most beneficial way to use the available personnel time must be tailored for each institution. To meet federal regulations, records must be kept of the environmental enhancements available to each nonhuman primate. Good record-keeping will allow appropriate evaluation of the program. This evaluation should involve the animals' responses to the enrichment opportunity, cost and durability of enrichment items, human and nonhuman safety considerations, and personnel required. The well-being of captive nonhuman primates will be most improved if well-informed decisions are made in developing and managing environmental enrichment programs.
Descriptors: record keeping, evaluation, enrichment plans.

Dewey, A. (1994). **The development of enrichment masterplan**. *Proceedings of the 20th National Conference of the American Association of Zoo Keepers, Inc.* Topeka, KS: AAZK, pp. 88-93.
NAL call number: QL76 A46 1993
Descriptors: planning, evaluation, enrichment plan, education, zoo primates.

National Research Council (1998). *The Psychological Well-Being of Nonhuman Primates*. National Academy Press: Washington, D.C., 168p.
NAL call number: SF407 P7P79 1988
Descriptors: guidelines, enrichment program elements, apes, cebids, prosimians, callitrichids, cercopithecids, research needs, sample plans.

Primate Environmental Enhancement Plans. 1990-Present
Collection of primate environmental enhancement plans prepared by research institutions and zoos from around the United States. Reports were prepared to meet USDA Animal Welfare Act mandate for providing for the "psychological well-being" of nonhuman primates.
NAL call number: HV4737 P75
Descriptors: environmental enrichment plans, psychological wellbeing, Animal Welfare Act.

Taylor, W.J. and M.L. Laudenslager (1998). **Low-cost environmental enrichment plan for laboratory macaques.** *Lab Animal* 27(4):28-31.
NAL call number: QL55 A1L33
Descriptors: psychological well-being, Animal Welfare Act, laboratory macaques.

Great Apes and Gibbons

Aureli, F. and F.B.M. DeWaal (1997). **Inhibition of social behavior in chimpanzees under high density conditions.** *American Journal of Primatology* 41(3):213-228.
NAL call number: QL737 P9A5
Descriptors: social behavior, crowding, captivity.

Baker, K.C. (1997). **Straw and forage material ameliorate abnormal beahviors in adult chimpanzees.** *Zoo Biology* 16(3):225-236.
NAL call number: QL77.5 Z6
Descriptors: substrate, foraging behavior, zoos, activity.

Baker, K.C. and F. Aureli (1996). **The neighbor effect: Other groups influence intragroup agonistic behavior in captive chimpanzees.** *American Journal of Primatology* 40(3):283-291.
NAL call number: QL737 P9A5
Descriptors: social behavior, dominance, aggression.

Baker, K.C. (1996). **Chimpanzees in single cages and small social groups: Effects of housing on behavior.** *Contemporary Topics in Laboratory Animal Science* 35(3):71-74.
NAL call number: SF405.5 A23
Descriptors: social housing, foraging, dominance, abnormal behaviors.

Baker, K.C. (1997). **Human interaction as enrichment for captive chimpanzees: A preliminary report.** *American Journal of Primatology* 42(2):92.
NAL call number: QL737 P9A5
Descriptors: human-animal bond, social behavior, training.

Bettinger, T., J. Wallis, and T. Carter (1994). **Spatial selection in captive adult female chimpanzees.** *Zoo Biology* 13(2):167-176.
NAL call number: QL77.5 Z6
Descriptors: spatial behavior, territoriality, zoos, social behavior.

Bloomsmith, M.A. and S.P. Lambeth (1995). **Effects of predictable versus unpredictable feeding schedules on chimpanzee behavior**. *Applied Animal Behaviour Science* 44(1): 65-74.
NAL call number: QL750 A6
Descriptors: chimpanzees, timing, predictability of feeding, species-appropriate behavior.

Bloomsmith, M.A., S.P. Lambeth, A.M. Stone, and G.E. Laule (1997). **Comparing two types of human interaction as enrichment for chimpanzees.** *American Journal of Primatology* 42(2): 96.
NAL call number: QL737 P9A5
Descriptors: human-animal bond, training, social behavior.

Bloomsmith, M.A., G.E. Laule, P.L. Alford, and R.H. Thurston (1994). **Using training to moderate chimpanzee aggression during feeding.** *Zoo Biology* 13(6):557-566.
NAL call number: QL77.5 Z6
Descriptors: human-animal bond, social behavior, dominance.

Brent, L. (1998). **Destructible toys as enrichment for captive chimpanzees**. *Journal of Applied Animal Welfare Science* 1(1):5-15.
NAL call number: HV4701 J68
The use of destructible objects or toys as enrichment for nonhuman primates has had promising results in terms of increased use and positive behavioral effect. The purpose of this project was to determine the use and durability of a number of inexpensive, destructible toys provided one at a time or several at once. Nine singly caged chimpanzees were provided with eight different toys made of

plastic, vinyl, or cloth and the frequency of use of the toys was determined during 15 min trials twice per day. The toy was removed when it was destroyed or when it was not contacted during four trials. The chimpanzees contacted the toys for an average of 11 times per trial, and the use of the individual toys was significantly higher when provided one at a time rather than all at once. Use of the toys was fairly stable over time, and the toys remained in the cages an average of 3.2 days. The durability of the toys was related to the type of toy, i.e., more flexible cloth and vinyl toys lasted longer than rigid plastic toys. The destructible toys were used significantly more often than other permanent cage toys or televisions. Toy use was not related to age, level of abnormal behavior or use of existing permanent toys or television. The implications of the results were related to the management of an environmental enrichment program, and indicate that the provision of flexible, inexpensive toys one at a time can be an effective method of enrichment for captive chimpanzees.
Descriptors: use, durability, timing, affects of age or abnormal behavior.

Brent, L. (1995). **Feeding enrichment and body weight in captive chimpanzees**. *Journal of Medical Primatology* 24(1):12-16.
NAL call number: QL737 P9J66
Although positive behavioral consequences have been attributed to feeding enrichment, physiological changes may also occur. In this study, the body weight records of a large chimpanzee colony were reviewed to determine if body weight was affected by the implementation of a daily enrichment program, including food items offered three to four times per week. Comparing the mean body weight by age groups indicated that the weight of female chimpanzees was significantly greater after feeding enrichment but that male body weight did not differ.

Brent L. (1992). **Woodchip bedding as enrichment for captive chimpanzees in an outdoor enclosure**. *Animal Welfare* 1(3):161-170.
NAL call number: HV4701 A557
Descriptors: *Pan troglodytes*, juveniles, behavior, evaluation, woodchips.

Brent, L. and A.M. Stone (1996). **Long-term use of televisions, balls, and mirrors as enrichment for paired and singly caged chimpanzees**. *American Journal of Primatology* 39(2):139-45.
NAL call number: QL737 P9A5
The evaluation of environmental enrichment techniques for nonhuman primates over long periods of time has had mixed results. Some studies report rapid habituation to new enrichment items, while others note continued use. We have investigated the use of three different enrichments that had been available to paired and singly caged chimpanzees for several years. Twenty subjects were observed during 200 hr of scan sampling while singly caged and while pair housed. Each subject had a variety of enrichments available and their use of a television, ball, and mirror were recorded. The chimpanzees had previous exposure to all of the items: televisions had been available for a mean of 22.75 months, balls had been available for 55.9 months, and mirrors had been available for 25.9 months. The results indicated that the chimpanzees continued to use the enrichments for small amounts of time (0.27%-1.53% of the observations) even after such prolonged exposure. Television and ball use were significantly higher than mirror use. Housing condition was not a significant factor in the analyses, contrary to expectations. We concluded that several simple enrichment items may be effective in offering variety and choices to the nonhuman primate and can be one element in a comprehensive environmental enhancement plan.
Descriptors: chimpanzees, laboratory, devices, enrichment plans.

Brown, D., J. Calcagno, K. Gold, and S. Thompson (1995). **Effects of environmental enrichment on nonsocial and abnormal behavior of captive lowland gorillas (*Gorilla gorilla gorilla*).** *American Zoo and Aquarium Association Regional Conference Proceedings* 1995:29-35.
NAL call number: QL76.5 U6A472
Descriptors: gorilla, zoos, behavior.

Brown, D. and K.C. Gold (1997). **Effects of straw bedding on non-social and abnormal behavior of captive lowland gorillas (*Gorilla gorilla gorilla*). Behavioral problems in captivity in general and their management**. In: *Proceedings of the 2nd International Conference on Environmental Enrichment, 21-25 August 1995, Copenhagen* B. Holst, ed., Copenhagen Zoo, Frederiksberg, pp 24-38.
Descriptors: gorilla, zoos, substrate, social behavior.

Burd L. and D. Moore (1991). **Primate enrichment: using novel stimuli for behavioral modification in captive gibbons**. AAZPA Regional Conference Proceedings 1991:505-511.
NAL call number: QL76.5 U6A472
Descriptors: Hylobates, housing, environmental enrichment.

Fritz, J. (1994). **Introducing unfamiliar chimpanzees to a group or partner.** *Laboratory Primate Newsletter* 33(1):5-7.
NAL call number: SF407 P7L3
Descriptors: social behavior, dominance, social housing.

Fritz, J., S.M. Howell and M.L. Schwandt (1997). **Colored light as environmental enrichment for captive chimpanzees (*Pan troglodytes).*** *Laboratory Primate Newsletter* 36:(2):1-4.
NAL call number: SF407 P7L3
Descriptors: novel stimulus, activity, behavior.

Gilloux, I., J. Gurnell, and D. Shepherdson (1992). *An enrichment device for great apes*. **Animal Welfare** 1(4): 279-289.
NAL call number: HV4701 A557
Descriptors: gorilla, chimpanzee, puzzle feeders, behavioral response, feeding behavior.

Goff, C., S. Menkhus-Howell, J. Fritz, and B. Nankivell (1994). **Space use and proximity of captive chimpanzee mother/offspring pairs.** *Zoo Biology* 13(1):61-68.
NAL call number: QL77.5 Z6
Descriptors: social housing, spatial behavior, pair bonds.

Heuer, A. and R. Hartmut (1998). **Environmental enrichment for four subadult orangutans (*Pongo pygmaeus abelii*) in the Zoological Garden of Hanover**. *Zoologische Garten* 68(2):119-133.
NAL call number: 410 Z724
Descriptors: manipulanda, habituation, novel objects.

Howell, S., E. Mittra, J. Fritz, and J. Baron (1997). **The provision of cage furnishings as environmental enrichment at the Primate Foundation of Arizona**. *Newsletter of the Primate Foundation Of Arizona* 9(2):1-5.
Descriptors: *Pan troglodytes*, cage props, environmental enrichment, chimpanzees.

Kessel, A. and L. Brent (1996). **Goldfish as enrichment for singly housed chimpanzees**. *Animal Technology* 47(1):1-8.
NAL call number: QL55 I5
Descriptors: goldfish, habitiuation, laboratory chimps, aquariums.

Kessel, A.L., L. Brent, and T. Walljasper (1995). **Shredded paper as enrichment for infant chimpanzees**. *Laboratory Primate Newsletter* 34(4):4-6.
NAL call number: SF407 P7L3
Descriptors: *Pan troglodytes*, infants, shredding paper.

Lambeth, S.P. and M.A. Bloomsmith (1992). **Mirrors as enrichment for captive chimpanzees (*Pan troglodytes*)**. *Laboratory Animal Science* 42(3):261-66.
NAL call number: 410.9 P94
At many facilities, limitations of the physical environment have reduced the opportunity for captive chimpanzees to live in large, naturalistic social groups. Convex mirrors used to increase visual access of neighboring groups may improve the social environment. This was tested in a study of 28 chimpanzees (*Pan troglodytes*) group-housed in conventional indoor/outdoor runs. A total of 47.8 hours of behavioral observations were conducted and comparisons made across three conditions: no mirror present, a mirror present with visual access to neighboring conspecifics, or a mirror present with visual access to the neighbors' empty run. When the mirror gave subjects visual access to neighboring animals, facial expressions, sexual, and agonistic behaviors increased, whereas affiliative behaviour decreased compared with when no mirror was present. When the mirror gave subjects visual access to a neighbors' empty run, facial expressions and sexual behavior increased compared with when no mirror was present. When the mirror gave subjects visual access to a neighbor's empty run, agonism decreased compared with when a mirror gave subjects visual access to neighboring animals. When subjects had visual access to neighbors, they used the mirror 30% of the total data points; while they had visual access to the neighbors' empty run, they looked during 24% of the total data points. Juveniles' use of the mirror increased over time while adults' use remained stable. Adult males used the mirror less than did the other subjects. These findings indicate that a mirror allowing visual access to neighboring conspecifics has potential as an enrichment device that affects social behavior.
Descriptors: mirrors, visual access, age dependence, social behavior.

Lukas K.E., M.P. Hoff, and T.L. Maple (1995). **Rotating gorilla troops through multiple exhibits at Zoo Atlanta's Ford African rainforest: A behavioral evaluation**. *American Zoo and Aquarium Association Annual Conference Proceedings* 1995:352-354.
NAL call number: QL76.5 U6A472
Descriptors: social behavior, novelty, zoo primates, gorillas.

Morris, A. and T. Bettinger (1991). **Chimpanzee enrichment at the Tulsa Zoo**. *AAZPA Regional Conference Proceedings* 1991:417-422.
NAL call number: QL76.5 U6A472
Descriptors: *Pan troglodytes*, enrichment, zoos.

Ogden, J.J., D.G. Lindburg, and T.L. Maple (1994). **A preliminary study of the effects of ecologically relevant sounds on the behaviour of captive lowland gorillas**. *Applied Animal Behaviour Science* 39(2):163-76.
NAL call number: QL750 A6
Descriptors: quiet, ventilation noise, caretaker sounds, vocalization playbacks, rainforest sounds, behavior, stress, age differences.

Pazol K.A. and M.A. Bloomsmith (1993). **The development of stereotyped body rocking in chimpanzees reared in a variety of nursery settings.** *Animal Welfare* 2(2):113-129.
NAL call number: HV4701 A557
Descriptors: abnormal behavior, novel stimulus, social behavior, treatment.

Perkins, L. (1992). **Variables that influence the activity of captive orangutans.** *Zoo Biology* 11(3):177-186.
NAL call number: QL77.5 Z6
Descriptors: zoos, social behavior, manipulanda, dominance.

Perret, K., H. Preuschoft, and S. Preuschoft (1995). **The impact of zoo visitors on the behavior of chimpanzees (*Pan troglodytes*)**. *Zoologische Garten* 65(5):314-32.
NAL call number: 410 Z724
Descriptors: stress from visitors, effects on social behavior of chimpanzees, play.

Perret, K., S. Buechner, and H. Joerg a Adler (1998). **Environmental enrichment programs for chimpanzees (*Pan troglodytes*) in zoos**. *Zoologische Garten* 68(2):95-111.
NAL call number: 410 Z724
Descriptors: tool use, foraging, social behavior, economic costs, benefits for wellbeing.

Preutz, J.D. and M.A. Bloomsmith (1992). **Comparing two manipulable objects as enrichment for captive chimpanzees.** *Animal Welfare* 1(2): 127-137.
NAL call number: HV4701 A557
Descriptors: devices, activity, behavior.

Rooney, M.B. and J. Sleeman (1998). **Effects of selected behavioral enrichment devices on behavior of Western lowland gorillas (*Gorilla gorilla gorilla*)**. *Journal of Applied Animal Welfare Science* 1(4):339-351.
NAL call number: HV4701 J68
Environmental complexity plays an integral role in the activity and psychological well-being of primates. The experiment described in this article evaluated the effects of nonintrusive, inexpensive, and easily managed behavioral enrichment devices on the behavior of a group of captive western lowland gorillas. Devices used included cardboard boxes containing food items, paper bags containing food items, burlap rags, willow, and maple browse. The enrichment devices increased foraging, social play, and solitary play behaviors. Sedentary behaviors decreased. Rags, bags, browse,

and boxes did not statistically decrease the incidence of regurgitation/reingestation or coprophagy. Depending on the type of enrichment item used, the effects on agonism and manipulation of enrichment item were variable. To make informed management decisions about the psychological well being of captive animals, it is important to objectively quantify and examine the influences on their behavior.
Descriptors: manipulanda, toys, zoos.

Russon, A.E. and B.M. Galdikas (1993). **Imitation in free-ranging rehabilitant orangutans (*Pongo pygmaeus*).** *Journal of Comparative Psychology* 107(2): 147-61.
NAL call number: BF671 J6
Descriptors: rehabilitation environments, learning, imitation.

Shefferly, N., J. Fritz , and S. Howell (1993). **Toys as environmental enrichment for captive juvenile chimpanzees (*Pan Troglodytes*).** *Laboratory Primate Newsletter* 32(2):7-9.
NAL call number: SF407 P7L3
Descriptors: toys, chimpanzees, laboratory.

Struthers, E.J., H. Harvey, and S. Walden (1997). **Utilization of a sensory diet approach for enrichment and mitigation of abnormal behaviors in captive chimpanzees (*Pan troglodytes*).** *American Journal of Primatology* 42(2):151.
NAL call number: QL737 P9A5
Descriptors: foraging, diet enrichment, stereotypies, behavior.

Sugiyama, Y. (1995). **Drinking tools of wild chimpanzees at Bossou.** *American Journal of Primatology* 37:263-269.
NAL call number: QL737 P9A5
Descriptors: wild chimpanzees, toolmaking, drinking, manipulanda.

Takemoto H, K. Kumazaki, and T. Matsuzawa (1996). **Selectivity in feeding behavior of planted trees by captive chimpanzees**. *Primate Research* 12(1):33-40.
Descriptors: diet, food preferences, foraging, zoos.

Takeshita, H. and J. Van Hooff (1996). **Tool use by chimpanzees (*Pan troglodytes*) of the Arnhem Zoo community**. *Japanese Psychological Research* 38(3):163-173.
Descriptors: zoos, tool use, age, play.

Wood, W. (1998). **Interactions among environmental enrichment, viewing crowds, and zoo chimpanzees (*Pan troglodytes*).** *Zoo Biology* 17(3):211-230.
NAL call number: QL77.5 Z6
Descriptors: zoos, visitors effects on behavior, foraging, object use, grooming, play.

Woods, S. (1995). **Facilitation of problem solving, tool use, and affiliative social behaviors in captive gorillas**. *American Zoo and Aquarium Association Regional Conference Proceedings* 1995:384-388.
NAL call number: QL76.5 U6A472
Descriptors: zoos, grooming, manipulanda, cognition.

Wood, W. (1997). **Changes in grooming and play behavior across three levels of enviromental complexity in an intensively housed group of zoo chimpanzees.** *American Journal of Primatology* 42(2):156.
NAL call number: QL737 P9A5
Descriptors: grooming, social behavior, play, complex housing, zoos.

Wright, B.W. (1995). **A novel item enrichment program reduces lethargy in orangutans**. *Folia Primatologica* 65(4):214-218.
NAL call number: QL737 P9F6
Descriptors: obesity, environmental enrichment, devices, novelty, zoos.

Wright, B.W. (1994). **A comparative analysis of the effects of behavioral enrichment and the utilization of tools within and between captive groups of western lowland gorillas (*Gorilla gorilla gorilla*) and Bornean orangutans (*Pongo pygmaeus pygmaeus*)**. *American Journal of Physical Anthropology* Suppl. 18:210-211.
Descriptors: abstract, tool use, manipulanda, social behavior.

Young, R.J., D. McNaught, and B. Richardson (1994). **Hand-manipulated food dispensers for Chimpanzees (*Pan troglodytes*)**. *RATEL* 21(3):85-86.
NAL call number: QL77.5 R37
Descriptors: devices, zoos, foraging behavior.

Macaques

Anderson, J.R., A. Rortais, and S. Guillemein (1994). **Diving and underwater swimming as enrichment activities for captive rhesus macaques (*Macaca mulatta*)**. *Animal Welfare* 3(4): 275-83.
NAL call number: HV4701 A557
In order to assess the environmental enrichment value of a small swimming pool for captive juvenile rhesus macaques (*Macaca mulatta*), observations of social and individual behaviours were made during baseline and experimental (pool) conditions. When the pool was available there was less social grooming and cage manipulation, and more play. Most of the monkeys engaged in diving and underwater swimming. The presence of pieces of banana at the bottom of the pool reduced these water-related activities, whereas when raisins were spread along the bottom or when there was no food in the water, there was more diving and less aggression. Certain effects tended to vary with dominance status, but individual differences appeared more important than social status in determining reactions to the water. The provision of a small swimming pool for captive macaques is an effective contribution to improving their welfare.
Descriptors: rhesus macaque, swimming pool, social behavior.

Bayne, K.A.L. and S. Dexter (1992). **Removing an environmental enrichment device can result in a rebound of abnormal behavior in rhesus monkeys.** *American Journal of Primatology* 27:15.
NAL call number: QL737 P9A5
Descriptors: atypical behavior, importance of environmental enrichment, devices.

Bayne, K.A.L., S.L. Dexter, and H. Mainzer (1992). **The use of artificial turf as a foraging substrate for individually housed rhesus monkeys (*Macaca mulatta*).** *Animal Welfare* 1(1):39-53.
NAL call number: HV4701 A557
Descriptors: substrate, foraging behavior, activity.

Bayne, K.A.L., J.K. Hurst, and S.L. Dexter (1992). **Evaluation of the preference to and behavioral effects of an enriched environment on male rhesus monkeys**. *Laboratory Animal Science* 42(1): 38-45.
NAL call number: 410.9 P94
Two environments were provided to laboratory rhesus monkeys to determine if the animals spent more time (for the purposes of this study, defined as the cage side preference) in an enriched cage side than an unenriched cage side. The side (right or left) of a double-wide cage in which the animal spent the most time (as determined by Chi square analysis) was initially determined during baseline obsevations. The "nonpreferred" side was then enriched during the experimental phase of the study. The enrichment consisted of a perch, a Tug-A-Toy suspended inside the cage, a Kong toy suspended on the outside of the cage, and a grooming board mounted on the outside of the cage. No statistically significant changes in use of the enrichments were detected over time. Fifty percent of the animals switched cage side preference to the enriched side during the study. All subjects showed reduced behavioral pathology during exposure to the enriched environment with a return of behavioral pathology when the enrichments were removed.
Descriptors: preference testing, cage size, toys, laboratory animals.

Bayne, K.A.L., G.M. Strange, and S.L. Dexter (1994). **Influence of food enrichment on cage side preference**. *Laboratory Animal Science* 44(6): 624-29.
NAL call number: 410.9 P94
A preference test paradigm was used to assess the value of two enrichment techniques for rhesus macaques (*Macaca mulatta*): (1) a Kong toy stuffed with food treats and (2) a fleece board covered with particulate food. The duration of time spent in the enriched cage side was compared with that spent in the unenriched cage side. Additionally, the number of cage side changes made during an observation interval and the duration and frequency of occurrence of select behaviors were recorded. Half the subjects altered their cage side preference during the experimental condition, and a fifth animal reversed side preference in the postexperimental phase. Subjects spent a mean time of 14% of a session engaged with the foraging devices. The occurrence of several behaviors, including self-directed and locomotor activities, varied significantly with the experimental condition. These results were compared with data from a previous preference study of nonnutritive enrichments, and a hypothesis regarding the relative value of different types of enrichment was developed.
Descriptors: Kong toy, foraging board, cage preferences, nonnutritive enrichment.

Blount, J.o.n.D. (1997). **Pond-dipping and a 'brunch' of flowers: enrichment for Sulawesi crested macaques at Newquay Zoo**. *Ratel* 24(4):135-137.
NAL call number: QL77.5 R37
Descriptors: *Macaca nigra*, zoos, flowers.

Boccia, M.L., M.L. Laudenslager, and M.L. Reite (1995). **Individual differences in macaques' responses to stressors based on social and physiological factors: Implications for primate welfare and research outcomes**. *Laboratory Animals* 29(3):250-7.
NAL call number: QL55 A1L3
Primates are used extensively in a variety of research settings. Federal regulations in the U.S. mandate that caretakers provide for the 'psychological well-being of laboratory primates'. One of the difficulties in implementing this law has been both in the definition of psychological well-being and in the need to deal with each primate species and, in some cases, age or sex class, uniquely. Non-human primates exhibit distinct individual differences in their behavioural and physiological responses to experimental challenges and caretaking procedures. We have been investigating what factors can predict some of these individual differences, and have found that factors both intrinsic and extrinsic are significant. Extrinsic factors found to predict individual differences in response to stressors include the nature and prior experience with the challenge, the presence of familiar peers and availability of social support. Intrinsic factors include cognitive interpretations of the challenge and temperamental differences in reactivity. These studies highlight the importance of understanding the context and individual psychology of macaques in order to provide laboratory environments conducive to their welfare, and in order to understand the impact experimental and caretaking procedures are likely to have on the health and welfare of our subjects.
Descriptors: *Macaca nemestrina*, *Macaca radiata*, stress, individual differences, psychology.

Bowers, C.L., C.M. Crockett, and D.M. Bowden (1998). **Differences in stress reactivity of laboratory macaques measured by heart period and respiratory sinus arrhythmia**. *American Journal of Primatology* 45(3): 245-61.
NAL call number: QL737 P9A5
Some laboratory primates are more likely than others to react to anxiety-provoking stressors. Individuals that overreact to stressors may experience diminished psychological well-being and would be inappropriate for some experiments. The differences between reactive and nonreactive individuals may be reflected in heart period and respiratory sinus arrhythmia (RSA). Using surface electrodes and radio telemetry, we measured these two cardiac variables in seven male and ten female singly caged longtailed macaques (*Macaca fascicularis*) when they were exposed to two stressors, a sudden noise (whistle test) and an unfamiliar technician wearing capture gloves (glove test). Behavior was videotaped during both tests. For the whistle test, cardiac data were recorded before, during, and after two 1 minute whistle blasts separated by 90 min. For the glove test, data were recorded in 1 minute blocks every 8 minutes over 96 minutes before, during, and after 1 minute exposure to the gloved technician. Heart period was decreased and RSA was suppressed during both the whistle and glove exposures. After the whistle test, the cardiac activity of most subjects returned to baseline levels within 10 minutes. The glove test produced more extended suppression, with greater individual differences, than the whistle test. There were greater individual differences in RSA than in heart period. These enhanced individual differences were used to define stress reactors that differed from nonreactors in their cardiac data profiles. Of 16 subjects that completed the glove test, five were identified as reactors.
Descriptors: stress, physiology, psychology, *Macaca fascicularis*.

Cardinal, B.R. and K.J. Stephen (1998). **Behavioral effect of simple manipulable environmental enrichment on pair-housed juvenile macaques (*Macaca nemestrina*).** *Laboratory Primate Newsletter* 37(1):1-3.
NAL call number: SF407 P7L3
Descriptors: enrichment devices, social housing, manipulanda.

Clark, A.S. and M.L. Schneider (1993). **Prenatal stress has long-term effects on behavioral responses to stress in juvenile rhesus monkeys.** *Developmental Psychobiology* 26(5):293-304.
Descriptors: distress, social behavior, laboratory.

Crockett, C.M., R.U. Bellanca, C.L. Bowers and D.M. Bowden (1997). **Grooming--contact bars provide social contact for individually-caged laboratory macaques.** *Contemporary Topics in Laboratory Animal Science* 36(6):53-60.
NAL call number: SF405.5 A23
Descriptors: individual housing, social behavior, devices.

Crockett, C.M., and D.M. Bowden (1994). **Challenging conventional wisdom for housing monkeys.** *Lab Animal* 23(2):29-33.
NAL call number: QL55 A1L33
Descriptors: social behavior, spatial behavior, performance standards, legislation.

Crockett, C.M., C.L. Bowers, D.M. Bowden, and G.P. Sackett (1994). **Sex differences in compatibility of pair-housed adult long-tailed macaques.** *American Journal of Primatology* 32(2):73-94.
NAL call number: QL737 P9A5
Descriptors: gender, social behavior, laboratory housing.

Crockett, C.M., C.L. Bowers, M. Shimoji, M. Leu, D.M. Bowden, and G.P. Sackett (1995). **Behavioral responses of longtailed macaques to different cage sizes and common laboratory experiences.** *Journal of Comparative Psychology* 109(4):368-83.
NAL call number: BF671 J6
The authors tested the effects of varying cage size on the behavior of 10 female and 10 male *Macaca fascicularis* by singly caging them for 2 weeks in each of 5 cage sizes, ranging from approximately 20% to 148% of regulation size. Behavior in the regulation cage size, a size 23% smaller, and a size 48% larger did not differ in any analysis. Locomotion was significantly less in the 2 smallest cage sizes. Abnormal behavior occurred only 5% of the time, did not increase as cage size decreased, and did not change significantly over nearly 3 years. Disruption of the normal activity budget in the laboratory environment proved to be a useful indicator of psychological well-being. Moving to a new room and, to a lesser extent, moving into a new, clean cage, regardless of size, was associated with disrupted sleep the 1st night and suppressed activity, especially self-grooming, the next day.
Descriptors: cage size, activity, self-grooming, abnormal behavior levels.

Eaton, G.G., S.T. Kelley, M.K. Axthelm, S.P. Iliff-Sizemore, and S.M. Shiigi (1994). **Psychological well being in paired adult female rhesus.** *American Journal of Primatology* 33:89-99.
NAL call number: QL737 P9A5
Descriptors: environmental enrichment, group housing, well-being.

Estep, D.Q. and S.C. Baker (1991). **The effects of temporary cover on the behavior of socially housed stumptailed macaques (*Macaca arctoides*).** *Zoo Biology* 10(6):465-472.
NAL call number: QL77.5 Z6
Descriptors: contact aggression, locomotion, copulation, affiliative behavior.

Fligiel, J. and V. Reinhardt (1994). **Assessing group housing for an aged female rhesus macaque.** *Laboratory Primate Newsletter* 33(4):10-12.
NAL call number: SF407 P7L3
Descriptors: social behavior, older animals, laboratory housing.

Gust, D.A., T.P. Gordon, A.R. Brodie, and H.M. McClure (1994). **Effect of a preferred companion in modulating stress in adult female rhesus monkeys.** *Physiology and Behavior* 55:681-684.
NAL call number: QP1 P4
Descriptors: distress, social behavior, physiological response.

Gust, D.A., T.P. Gordon, M.E. Wilson, A.R. Brodie, A. Ahmed-Ansari, H.M. McClure, and G.R. Lubach (1996). **Group formation of female pig tailed macaques.** *American Journal of Primatology* 39(4): 263-273.
NAL call number: QL737 P9A5
Descriptors: social behavior, group housing.

Holmes, S.N., J.M. Riley, P. Juneau, D. Pyne, and G.L. Hofing (1995). **Short-term evaluation of a foraging device for non-human primates**. *Laboratory Animals* 29(4):364-69.
NAL call number: QL55 A1L3
In the USA, any institution involved in using non-human primates for research has had, for regulatory reasons, to address the psychological needs of these animals. Enriching the environment through the use of foraging devices has been one method and a study was designed to evaluate the short-term effect of a new foraging device on singly-housed cynomolgus monkeys. The study was divided into 3 one-week periods of observation: baseline, device filled with normal ration, and device filled with a novel food. Four behaviours were recorded: foraging, self-directed, hopper feeding, and other behaviours. During the observation periods the device was accepted in preference to the standard hopper style feeder and self-directed behaviours were significantly reduced compared with the baseline period. Changing to a novel food re-kindled interest in the device and reduced the extinguishing effect: i.e. decrease in interest or use of the device. Based on this study, the feeder has been included with several other devices in a rotation programme.
Descriptors: novel food, feeder, *Macaca fascicularis*, cynomologus macaque, feeding behavior.

Kessel, A.L. and L. Brent (1998). **Cage toys reduce abnormal behavior in individually housed pigtail macaques**. *Journal of Applied Animal Welfare Science* 1(3):227-234.
NAL call number: HV4701 J68
As part of a behavioral intervention program that identifies and treats individual nonhuman primates exhibiting abnormal behavior, five individually housed pigtail macaques (Macaca nemestrina) were provided with multiple cage toys in an effort to reduce high levels of abnormal behavior. Ten 30-minute observations of each subject were conducted during the baseline condition, and again after novel toys were presented loose inside the cage, and attached to the outside of the cage. The new toys were used during 27% of the observation time. Kong Toys™ were used most consistently by the macaques during the 5-week observation period. Significant decreases in abnormal behavior and

cage-directed behavior, as well as significantly increased enrichment use, were evident after the toys were added. Several of the toys were quickly destroyed, and individual differences were evident in the levels of enrichment use and abnormal behavior. Providing multiple manipulable toys as enrichment for pigtail macaques was effective in reducing abnormal behavior and was an important part of an environmental enrichment program for monkeys who could not be socially housed.
Descriptors: toys, placement on cage, abnormal behavior, single housing.

Lehman, S.M. and R.G. Lessnau (1992). **Pickle barrels as enrichment objects for rhesus macaques.** *Laboratory Animal Science* 42(4): 392-97.
NAL call number: 410.9 P94
Two breeding groups of rhesus monkeys (*Macaca mulatta*) housed in outdoor enclosures on Key Lois island were observed for 84 hours. Instantaneous scan sampling of a focal animal was used to gather data to test hypotheses concerning frequencies of agonistic and affiliative behaviors as well as differential use of pickle barrels as enrichment objects. Type of barrel used, behavior, and age/sex class of the animal were noted. Barrels were arranged three ways: unattached, on a swivel, and stationary. The behaviors of animals in an enriched environment were compared with control condition animals, which did not have pickle barrels. Animals in an enriched environment accounted for 60.8% (n = 56) of total affiliative contact, 62.2% (n = 399) of total social grooming, and 26% (n = 5) of total agonistic noncontact. A total of 134 scans of barrel use were observed. Analyses of the data showed that swivel and stationary barrels were used the most (55% of all scans of barrel use). Yearlings, juvenile females, and old males used barrels most often (82.8% of all scans of barrel use), although they constituted only 39% of the enriched environment populations. In this study, pickle barrels provided enrichment for young and old animals of both sexes.
Descriptors: Macaca mulatta, agonistic and affiliative behavior, age of individual.

Leu, M., C.M. Crockett, C.L. Bowers, and D.M. Bowden (1993). **Changes in activity levels of singly housed long tailed macaques when given the opoortunity to exercise in a larger cage.** *Journal of Comparative Psychology* 109(4):368.
NAL call number: BF671 J6
Descriptors: social behavior, activity level, exercise, spatial behavior.

Lincoln, H. III, M.W. Andrews, and L.A. Rosenblum (1995). **Pigtail macaque performance on a challenging joystick task has important implications for enrichment and anxiety within a captive environment.** *Laboratory Animal Science* 45(3): 264-8.
NAL call number: 410.9 P94
The purpose of this study was to extend previous findings on joystick task engagement by a group of pigtail macaques. The goals were to determine the influence of task difficulty on daily levels of task activity and to test the hypothesis that previously identified preferences among identical devices at different locations derived largely from the level of anxiety induced at each location. It was found that the number of daily trials decreased when the task was made more difficult, with more time required to complete each trial with the difficult task. Preferences among locations became more pronounced with the more difficult task. Analysis of errors made on devices at different locations supported the view that preferences did derive, at least in part, from levels of induced anxiety. Locations of enrichment devices may influence not only amount of use but also levels of anxiety in captive monkeys.
Descriptors: Macaca nemestrina, anxiety, preference, device location.

Lincoln, H. III, M.W. Andrews, and L.A. Rosenblum (1994). **Environmental structure influences use of multiple video-task devices by socially housed pigtail macaques**. *Applied Animal Behaviour Science* 41(1-2):135-43.
NAL call number: QL750 A6
Descriptors: video enrichment, perch provision, social housing, *Macaca nemestrina*.

Line, S.W., A.S. Clarke, H. Markowitz, and G. Ellman (1990). **Responses of female rhesus macaques to an environmental en richment apparatus**. *Laboratory Animals* 24(3):213-20.
NAL call number: QL55 A1L3
Environmental enrichment devices are a potential way to enhance psychological well-being in laboratory animals. The effects of such devices need to be systematically evaluated before they are recommended for widespread use. The purpose of this research was to monitor the behavioural and physiological responses of adult female rhesus macaques to a simple enrichment device. The apparatus consisted of a box attached to the monkey's home cage that contained a radio and a food dispenser, which could be controlled by the monkeys via contact detectors. Radio and food dispenser use were automatically recorded. Whole blood serotonin (WBS), plasma cortisol and abnormal behaviour were measured in 5 monkeys before, during and after a 20-week period in which the monkey's cages were equipped with the device. All monkeys used the device (3 of the 5 subjects earned an average of more than 200 food pellets per day). Mean plasma cortisol and whole blood serotonin did not differ across sampling times, suggesting that the apparatus had no effect on basal stress levels. There was an inverse relationship between apparatus use and cortisol levels in 76% of the samples, but only 3 of 17 coefficients were significant. There was a significant but small negative correlation between apparatus use and self-abusive behaviour. This enrichment device was readily used by adult rhesus monkeys and could be adapted for use in a wide variety of laboratory settings.
Descriptors: food dispenser, stress, cortisol, abnormal behavior.

Line, S.W. and K.N. Morgan (1991). **The effects of two novel objects on the behavior of singly caged adult rhesus macaques**. *Laboratory Animal Science* 41(4):365-69.
NAL call number: 410.9 P94
Six female and six male adult rhesus macaques were given sticks and nylon balls as an attempt at simple cage enrichment. A latin square design was used to compare behavior during separate 4-week periods with each object and during a control period with no object. Frequency and duration of 15 different behaviors were recorded. Resting was the most common activity which decreased slightly in duration when the stick or nylon ball was present ($P < 0.02$). The mean duration of stick use was longer than that of the nylon ball ($P < 0.01$). No other behaviors changed significantly, including the frequency of abnormal behaviors such as self-abuse, stereotypic acts, and bizarre postures. Generally, these objects were used infrequently and led to few changes in the behavior of singly-caged adult rhesus macaques. However, they did appear to stimulate activity for some individuals.
Descriptors: *Macaca mulatta*, sticks, nylon balls, behavioral changes.

Line, S.W., K.N. Morgan, and H. Markowitz (1991). **Simple toys do not alter the behavior of aged rhesus monkeys**. *Zoo Biology* 10(6): 473-84.
NAL call number: AL77.5 Z6
Descriptors: toys, sticks, effectiveness, abnormal behavior.

Ljungberg, T., K. Westlund, and L. Rydn (1997). **Ethological studies of well-being in two species of macaques after transition from single-cages to housing in social groups.** In *Abstracts of the*

Second EUPREN/EMRG Winter Workshop : The housing of non-human primates used for experimental and other scientific purposes: Issues for consideration, Rome 27.09.1996. (Monograph online available from: http://www.dpz.gwdg.de:80/eupren/eupren.htm [March 23, 1998].) European Primate Resources Network (EUPREN).
Descriptors: social housing, compatability, behavior, mixed species.

Luttrell, L., L. Acker, M. Urben, and V. Reinhardt (1997). **Training a large troop of rhesus macaques to cooperate during catching: Analysis of the time investment.** *Animal Welfare* 3(2): 135-140.
NAL call number: HV4701 A557
Descriptors: positive reinforcement, capture, handling, training, laboratory.

Lutz, C.K., and R.A. Farrow (1996). **Foraging device for singly housed longtailed macaques does not reduce stereotypies.** *Contemporary Topics in Laboratory Animal Science* 35(3):75-78.
NAL call number: SF405.5 A23
Descriptors: devices, atypical behavior, single housing.

Lutz, C.K. and M.A. Novak (1995). **Use of foraging racks and shavings as enrichment tools for groups of rhesus monkeys (*Macaca mulatta*).** *Zoo Biology* 14(5):463-74.
NAL call number: QL77.5 Z6
Descriptors: foraging, social behavior, devices.

Lynch, R. (1998). **Successful pair housing of male macaques.** *Laboratory Primate Newsletter* 37(1):4-6.
NAL call number: SF407 P7L3
Descriptors: social housing, aggression, dominance.

Murchison, M.A. and E. Renolt (1992). **Food puzzle for single caged primates**. *American Journal Of Primatology* 27(4):285-292.
NAL call number: QL737 P9A5
Descriptors: pigtailed macaques, foraging behavior, puzzles, peanut rewards, control.

Palombit, R.A. (1992). **A preliminary study of vocal communication in wild long-tailed macaques: II. Potential of calls to regulate intragroup spacing.** *International Journal of Primatology* 13(2):183-207.
NAL call number: QL737 P9I54
Descriptors: spatial behavior, social behavior, importance of vocal communication.

Parks, K. A. and M.A. Novak (1993). **Observations of increased activity and tool use in captive rhesus monkeys exposed to troughs of water**. *American Journal of Primatology* 29(1):13-25.
NAL call number: AL737 P9A5
Descriptors: standing water, running water, combination with novel objects, exploration, social contact, grooming, water enrichment.

Platt, D.M. and M.A. Novak (1997). **Video stimulation as enrichment for captive rhesus monkeys (*Macaca mulatta*).** *Applied Animal Behaviour Science* 52(1/2):139-155.
NAL call number: QL750 A6
Descriptors: video games, video tapes, effects on social behavior, habituation, single housed.
Reinhardt, V. (1997). **Refining the traditional housing and handling of research macaques.** (Monograph online available at http://pantheon.yale.edu/~seelig/pef/new/new.html), 9p.
Descriptors: space utilization, social behavior, training.

Reinhardt, V. (1997). **The Wisconsin Gnawing Stick.** *Animal Welfare Information Center Newsletter* 7(3/4):11.
NAL call number: aHV4701 A952
Descriptors: branches, perches, social housing, single house, foraging.

Reinhardt, V. (1996). **Frequently asked questions about safe pair-housing of macaques.** *Animal Welfare Information Center Newsletter* 7(1):11.
NAL call number: aHV4701 A952
Descriptors: dominance, pairing, male pairs, stress, methods.

Reinhardt, V. (1995). **Arguments for single-caging of rhesus macaques: Are they justified?** *Animal Welfare Information Center Newsletter* 6(1):1-2, 7-8.
NAL call number: aHV4701 A952
Descriptors: familiarity, dominance, pairing, male pairs, stress, methods.

Reinhardt, V. (1994). **Caged rhesus macaques voluntarily work for ordinary food.** *Primates* 35(1): 95-98.
Descriptors: food puzzles, motivation, preferences, foraging behavior.

Reinhardt, V. (1994). **Continuous pair-housing of caged *Macaca mulatta*: Risk evaluation.** *Laboratory Primate Newsletter* 33(1):1-4.
NAL call number: SF407 P7L3
Descriptors: group housing, spatial behavior, dominance, social enrichment.

Reinhardt, V. (1994). **Pair-housing rather than single-housing for laboratory rhesus macaques.** *Journal of Medical Primatology* 23(8):426-31.
NAL call number: QL737 P9J66
Descriptors: social housing, injury rate, animal welfare.

Reinhardt, V. (1993). **Enticing nonhuman primates to forage for their standard biscuit ration.** *Zoo Biology* 12(3):307-312.
NAL call number: QL77.5 Z6
Descriptors: food puzzles, group housed macaques, feeder boxes, foraging behavior.

Reinhardt, V. (1993). **Using the mesh ceiling in a food puzzle to encourage foraging behavior in caged rhesus macaques.** *Animal Welfare* 2(2):165-172.
NAL call number: HV4701 A557
Descriptors: foraging behavior, devices, food puzzle.

Reinhardt, V. and S. Hurwitz (1993). **Evaluation of social enrichment for aged rhesus macaques.** *Animal Technology* 44(1):53-57.
NAL call number: QL55 I5
Descriptors: pair formations, behavioral interactions, affiliative interactions.

Reinhardt, V., C. Liss, and C. Stevens (1996). **Space requirement stipulations for caged non-human primates in the United States: A critical review.** *Animal Welfare* 5(4):361-372.
NAL call number: HV4701 A557
Descriptors: housing, guidelines, legislation, Animal Welfare Act.

Reinhardt, V., C. Liss, and C. Stevens (1995). **Social housing of previously single-caged macaques: What are the options and the risks?** *Animal Welfare* 4(4):307-328.
NAL call number: HV4701 A557
Descriptors: group housing, separation, dominance, adjustment.

Reinhardt, V. and D. Seelig (1998). *Environmental enhancement for caged rhesus macaques: A photographic documentation.* Animal Welfare Institute: Washington, D.C., 47p.
NAL call number: HV4737 R45 1998
Descriptors: group housing, feeding and grooming devices, atypical behavior.

Schapiro, S.J. and M.A. Bloomsmith (1995). **Behavioral effects of enrichment on singly-housed, yearling rhesus monkeys: An analysis including three enrichment conditions and a control group.** *American Journal of Primatology* 35, no. 2: 89-101.
NAL call number: QL737 P9A5
Descriptors: physical, feeding, and sensory enrichment; species-typical behavior; activity.

Schapiro, S.J. and M.A. Bloomsmith (1994). **Behavioral effects of enrichment on pair-housed juvenile rhesus monkeys.** *American Journal of Primatology* 32(3):159-170.
NAL call number: QL737 P9A5
Descriptors: pair-housed monkeys, inanimate enhancement vs. companionship, behavior.

Schapiro, S.J., M.A. Bloomsmith, A.L. Kessel, and C.A. Shively (1993). **Effects of enrichment and housing on cortisol response in juvenile rhesus monkeys.** *Applied Animal Behaviour Science* 37(3): 251-263.
NAL call number: QL750 A6
Descriptors: stress, social housing, inanimate enrichment, adrenal function.

Schapiro, S.J., M.A. Bloomsmith, L.M. Porter, and S.A. Suarez (1996). **Enrichment effects on rhesus monkeys successively housed singly, in pairs, and in groups.** *Applied Animal Behaviour Science* 48(3/4):159-171.
NAL call number: QL750 A6
Descriptors: long-term effects, inanimate and social enrichment, preferences.

Schapiro, S.J., M.A. Bloomsmith, S.A. Suarez, and L.M. Porter (1997). **A comparison of the effects of simple versus complex environmental enrichment on the behaviour of group-housed, subadult rhesus macaques**. *Animal Welfare* 6(1):17-28.
NAL call number: HV4701 A557
Descriptors: social housing, complexity, environmental enrichment.

Schapiro, S.J., M.A. Bloomsmith, S.A. Suarez, and L.M. Porter (1996). **Effects of social and inanimate enrichment on the behavior of yearling rhesus monkeys**. *American Journal of Primatology* 40(3):247-260.
NAL call number: QL737 P9A5
Descriptors: laboratory primates, social conditions, effects on use of enrichment objects.

Schapiro, S.J., M.A. Bloomsmith, S.A. Suarez, and L.M. Porter (1995). **Maternal behaviour of primiparous rhesus monkeys: Effects of limited social restriction and inanimate environmental enrichment**. *Applied Animal Behaviour Science* 45(1/2):139-149.
NAL call number: QL750 A6
Descriptors: social restriction, maternal competance, infants, visual access to conspecifics.

Schapiro, S.J. and D. Bushong (1994). **Effects of enrichment on veterinary treatment of laboratory rhesus macaques (*Macaca mulatta*)**. *Animal Welfare* 3(1):25-36.
NAL call number: HV4701 A557
Descriptors: social housing, single housing, therapy length.

Schapiro, S.J. and A.L. Kessel (1993). **Weight gain among juvenile rhesus macaques: A comparison of enriched and control groups**. *Laboratory Animal Science* 43(4): 315-318.
NAL call number: 410.9 P94
Environmental enrichment techniques for captive primates are aimed at improving their psychological well-being. While behavioral variables are used to measure changes in psychological well-being, physiologic measures (e.g., heart rate, cortisol response) are sometimes gathered in addition to the behavioral evidence. Some of these physiologic indices measure acute changes in the animals' well-being, limiting their usefulness. Body weight, however, is a measure of physical well-being that may have meaning as a long-term indicator of psychological well-being. We therefore collected body weight data from two groups of rhesus macaques (Macaca mulatta group 1: n = 34, group 2: n = 30) every 8 weeks beginning at the age of 1 year, as they passed through various housing conditions as part of a program to develop a specific pathogen-free breeding colony. One-half of the subjects in each group received a variety of environmental enhancements during all housing conditions; the other half received no enrichment and served as controls. At the beginning of the study (age 1 year), control and enriched subjects did not differ in body weight. Among group-1 subjects, enriched animals weighed significantly more than controls after 4 months of enrichment, and the weight difference was maintained 24 months later. Enriched animals in group 2 never differed in weight from their controls. The order in which different types of enrichment were presented and the extra-cage environment of the two groups differed, which may account for this discrepancy. Group-1 enriched subjects were the only animals that weighed as much as free-ranging rhesus monkeys, and rates of weight gain among all groups of subjects were similar to several populations maintained under more naturalistic conditions.
Descriptors: body weight, enrichment effects, housing conditions, social behavior.

Schapiro, S.J., D.E. Lee-Parritz, L.L. Taylor, L. Watson, M.A. Bloomsmith, and A. Petto (1994). **Behavioral management of specific pathogen-free rhesus macaques: group formation, reproduction, and parental competence.** *Laboratory Animal Science* 44(3):229-234.
NAL call number: 410.9 P94
Descriptors: compatability, dominance, aggression, separation.

Schapiro, S.J., P.N. Nehete, J.E. Perlman, M.A. Bloomsmith, and K.J. Sastry (1998). **Effects of dominance status and environmental enrichment on cell-mediated immunity in rhesus macaques**. *Applied Animal Behaviour Science* 56(2/4):319-332.
NAL call number: QL750 A6
Descriptors: hierarchy, lymphocytes, toys, cytokines.

Schapiro, S.J., P.N. Nehete, J.E. Perlman, and K.J. Sastry (1997). **Social housing condition affects cell-mediated immune responses in adult rhesus macaques.** *American Journal of Primatology* 42(2):147.
NAL call number: QL737 P9A5
Descriptors: immunosuppression, group housing, social behavior.

Schapiro, S.J., L.M. Porter, S.A. Suarez, and M.A. Bloomsmith (1995). **The behaviour of singly-caged, yearling rhesus monkeys is affected by the environment outside of the cage**. *Applied Animal Behaviour Science* 45(1/2):151-163.
NAL call number: QL750 A6
Descriptors: indoor vs. outdoor housing, social groups, naturalistic stimulation.

Schapiro, S.J., S.A. Suarez, L.M. Porter, and M.A. Bloomsmith (1996). **The effects of different types of feeding enhancements on the behaviour of single-caged, yearling rhesus macaques**. *Animal Welfare* 5(2):129-138.
NAL call number: HV4701 A557
Descriptors: foraging behavior, environmental enrichment, macaques.

Schneider, M.L., C.F. Moore, S.J. Suomi, and M. Champoux (1991). **Laboratory assessment of temperament and environmental enrichment in rhesus monkey infants (*Macaca mulatta*)**. *American Journal of Primatology* 25(3):137-156.
NAL call number: QL737 P9A5
Descriptors: standard cage vs. enriched environment, problem-solving, fearfulness.

Schneider, M.L. and S.J. Suomi (1992). **Neurobehavioral assessment in rhesus monkey neonates (*Macaca mulatta*): Developmental changes, behavioral stability, and early experience**. *Infant Behavior and Development* 15(2):155-177.
NAL call number: BF723 I6I53
Descriptors: development, stability, early experience, surrogate rearing, toys, fear.

Shimoji, M., C.L. Bowers, and C.M. Crockett (1993). **Initial response to introduction of of a PVC perch by singly caged *Macaca fascicularis*.** *Laboratory Primate Newsletter* 32(4):8-11.
NAL call number: SF407 P7L3
Descriptors: perches, device, single housing.

Taylor, R.L., B.L. White, S.A. Ferguson, and Z.K. Binienda (1994). **The use of foraging devices for environmental enrichment of individually housed rhesus monkeys in a laboratory colony.** *Contemporary Topics in Laboratory Animal Science* 33(6):71-73.
NAL call number: SF405.5 A23
Descriptors: devices, foraging behavior, laboratory primates.

Taylor, W.J., D.A. Brown, W.L. Davis, and M.L. Laudenslager (1997). **Novelty influences use of play structures by a group of socially housed bonnet macaques.** *Laboratory Primate Newsletter* 36(1):4-6.
NAL call number: SF407 P7L3
Descriptors: play, devices, social behavior.

Taylor, W.J. and M.L. Laudenslager (1998). **Low-cost environmental enrichment plan for laboratory macaques.** *Lab Animal* 27(4):28-31.
NAL call number: QL55 A1L33
Descriptors: psychological well-being, Animal Welfare Act, laboratory macaques.

Tustin, G.W., L.E. Williams, and A.G. Brady (1996). **Rotational use of a recreational cage for the environmental enrichment of Japanese macaques.** *Laboratory Primate Newsletter* 35(1):5-7.
NAL call number: SF407 P7L3
Descriptors: play, devices, housing, well-being.

Washburn, D.A., S. Harper, and D.M. Rumbaugh (1994). **Computer-task testing of rhesus monkeys (*Macaca mulatta*) in the social milieu**. *Primates* 35(3):343-351.
Descriptors: pair-housing, preference for computer interactions, cognition, psychology.

Yanagihara, Y., K. Matsubayashi, and T. Matsuzawa (1994). **Environmental enrichment in Japanese monkeys: Feeding device and cage environment**. *Primate Research* 10(2):95-104.
Descriptors: macaques, foraging behavior, devices.

Marmosets and Tamarins

Beck Rupert, P.A. (1995). **A study of environmental enrichment in groups of captive lion tamarins (*Leontopithecus rosalia* & *Leontopithecus chrysomelas*)**. *RATEL* 22(4):112-126.
NAL call number: QL77.5 R37
Descriptors: enrichment devices, evaluation, golden lion tamarins, endangered species.

Box, H.O. and P. Smith (1995). Age and gender differences in response to food enrichment in family groups of captive marmosets (Callithrix, Callitrichidae). *Animal Technology* 46(1):11-18.
NAL call number: QL55 I5
Descriptors: food preferences, group and age differences, behavioral responses.

Buchanan Smith, H. (1994). **Environmental enrichment in captive marmosets and tamarins.** *Humane Innovations and Alternatives* 8:559-564.
NAL call number: QL55 H8
Descriptors: marmosets, tamarins, animal welfare, behavior.

Buchanan Smith, H.M. (1993). **Environmental enrichment for captive marmosets and tamarins.** *Proceedings of Symposium of The Association of British Wild Animal Keepers* 17:56-65.
NAL call number: SK351 A8
Descriptors: marmosets, tamarins, enrichment, review.

Buchanan-Smith, H.M., D.A. Anderson, and C.W. Ryan (1993). **Responses of cotton-top tamarins (*Saquinus oedipus*) to faecal scents of predators and non-predators.** *Animal Welfare* 2 (1):17-32.
NAL call number: HV4701 A557
Descriptrors: olfactory enrichment, novel stimulus, curiosity, exploratory behavior.

Caine, N.G. and V.J. O'Boyle (1992). **Cage design and configuration of play in red-bellied tamarins, *Saguinus labiatus*.** *Zoo Biology* 11:215-220.
NAL call number: QL77.5 Z6
Descriptors: social behavior, play, housing design.

Caine, N.G., M.P. Potter and E. Mayer (1992). **Sleeping site selection by captive tamarins (*Saguinus labiatus*).** *Ethology* 90(1):63.
NAL call number: QL750 E74
Descriptors: nesting, spatial use, social behavior, resting.

Castro, M.I., B. Beck, D. Kleiman, G. Ruiz Miranda, R. Carlos, and A.L. Rosenberger (1998). **Environmental enrichment in a reintroduction program for golden lion tamarins (*Leontopithecus rosalia*).** In: *Second Nature: Environmental Enrichment for Captive Animals*. D.J. Shepherdson, J.D. Mellen, and M. Hutchins, eds., Smithsonian Institution Press: Washington, D.C., pp. 113-128.
NAL call number: SF408 5435 1998
Descriptors: zoos, field research, survival, reintroduction, tamarins.

Garber, P.A. and U. Kitron (1997). **Seed swallowing in tamarins: Evidence of a curative function or enhanced foraging efficiency?** *International Journal of Primatology* 18(4):523-538.
NAL call number: QL737 P9I54
Descriptors: foraging enrichment, *Saguinus geoffroyi*, *S. mystax*, parasites.

Glick-Bauer, M. (1997). **Behavioral enrichment for captive cotton-top tamarins (*Saguinus oedipus*) through novel presentation of diet.** *Laboratory Primate Newsletter* 36(1):1-3.
NAL call number: SF407 P7L3
Descriptors: food presentation, foraging behavior, diet, enrichment.

Heath, M. and S.E. Libretto (1993). **Environmental enrichment for large scale marmoset units.** *Animal Technology* 44(3):163-73.
NAL call number: QL55 I5
Descriptors: devices, social groups, sanitation, animal handling, technician role, *Callithrix jacchus*.

Kelley, K. (1993). **Environmental enrichment for captive wildlife through the simulation of gum-feeding**. *Animal Welfare Information Center Newsletter* 4(3):1-2, 5-10.
NAL call number: aHV4701 A952
Descriptors: exudativory, gummivory, nutrition, wood feeders, therapeutic value, natural behaviors.

Kerl, J. and H. Rothe (1996). **Influence of cage size and cage equipment on physiology and behavior of common marmosets.** *Laboratory Primate Newsletter* 35(3):10-13.
NAL call number: SF407 P7L3
Descriptors: spatial behavior, cage furnishings, physiological responses.

Kerl, J. (1997). **Measuring psychological well-being: A methodological approach using heart rate telemetry, space utilization, and behavioral time budgets in common marmosets.** In *Abstracts of the Second EUPREN/EMRG Winter Workshop : The housing of non-human primates used for experimental and other scientific purposes: Issues for consideration, Rome 27.09.1996.*
Monograph online available from: http://www.dpz.gwdg.de:80/eupren/eupren.htm European Primate Resources Network (EUPREN).
Descriptors: physiology, spatial behavior, activity frequency, heart rate.

Kitchen, A.M. and A.A. Martin (1996). **The effects of cage size and complexity on the behaviour of captive common marmosets, *Callithrix jacchus jacchus*.** *Laboratory Animals* 30(4): 317-326.
NAL call number: QL55 A1L3
Conditions of captivity of primates used in biomedical research may have deleterious effects on the welfare of the animals and consequently on the reliability of the research. We investigated the effects of cage size and cage complexity, two fundamental characteristics of captive conditions, on the behaviour of the common marmoset (*Callithrix jacchus jacchus*). We found an increase in the general level of activity and significant variation in the frequencies of specific behaviours with an increase in cage size and also with cage complexity. Stereotyped behaviours, which occurred in the small cages, were never exhibited in the large cages. The effect of the novelty of the changed conditions was also assessed and found to be significant for some behaviours. We also measured the time taken to capture an animal, a task frequently performed by the animal technician, under the various cage conditions. Capture time increased significantly in the larger cages, but the overall effect of the changes to the marmosets' housing conditions on the animal technician's work was not regarded as substantial. We conclude that the welfare of captive marmosets is enhanced by the provision of larger and more complex cages, and that such cages do not significantly affect the efficiency of the research laboratory.
Descriptors: laboratory marmosets, cage size, stereotypies, novelty, capture time.

LeBlanc, D. (1993) **Tamarins also feed on exudates.** *The Shape of Enrichment* 2(3):5.
NAL call number: HV4737 S53
Descriptors: gummivory, nutrition, foraging behavior.

Rapaport, L.G. (1998). **Optimal foraging theory predicts effects of environmental enrichment in a group of adult golden lion tamarins**. *Zoo Biology* 17(3):231-244.
NAL call number: QL77.5 Z6
Descriptors: foraging device, aggression, search time, task complexity, group housing.

Ruiz, J.C. (1993). **Effects of the cohabitation time on scent marking: Behaviors in heterosexual adult pairs of the golden lion tamarin.** *Primate Report* 37:15-18.
Descriptors: olfactory enrichment, pair bonding, social behavior.

Scott, L. (1997). **Specific requirements of Callitrichidae species.** In *Abstracts of the Second EUPREN/EMRG Winter Workshop : The housing of non-human primates used for experimental and other scientific purposes: Issues for consideration, Rome 27.09.1996.* (Monograph online available from: http://www.dpz.gwdg.de:80/eupren/eupren.htm European Primate Resources Network (EUPREN).
Descriptors: space, social groupings, foraging needs, behavioral requirements.

Stafford, B.J., A.L. Rosenberger, and B.B. Beck (1994). **Locomotion of free-ranging golden lion tamarins (*Leontopithecus rosalia*) at the National Zoological Park**. *Zoo Biology* 13(4):333-344.
NAL call number: QL77.5 Z6
Descriptors: zoos, foraging behavior, social behavior, reintroduction program.

Steen, Z. (1995). **Effects of enriched food acquisition on activity budgets of two tamarin species at Adelaide Zoo**. *International Zoo News* 42(5):284-298.
NAL call number: QL76 I58
Descriptors: golden lion tamarin, cotton top tamarin, *Saguinus oedipus*, foraging, activity.

Wassel, K. and S. Race (1994). **Tamarin enrichment at the Utica Zoo.** *The Shape of Enrichment* 3(1):1-2.
NAL call number: HV4737 S53
Descriptors: devices, tamarins, novelty stimulus.

New World Monkeys

Adams, B.W., E.R. Adair, M.C. Olsen, and M.S. Fritz (1992). **Two squirrel monkey toys.** *Laboratory Primate Newsletter* 31(4): 11-12.
NAL call number: SF407 P7L3
Descriptors: laboratory, devices, behavior.

Boinski S., C. Noon, S. Stans, R. Samudio, P. Sammarco, and A. Hayes (1994). **The behavioral profile and environmental enrichment of a squirrel monkey colony.** *Laboratory Primate Newsletter* 33(4): 1-4.
NAL call number: SF407 P7L3
Descriptors: laboratory, devices, behavior.

Buchanan-Smith, H.M. (1997). **Considerations for the housing and handling of New World primates in the laboratory.** In: *Comfortable Quarters for Laboratory Animals, Eighth Edition, 1997*, V. Reinhardt, ed., Animal Welfare Institute: Washington, D.C., pp. 75-84.
NAL call number: SF406.3 C66 1997
Descriptors: climate, cage size, complexity, diet, foraging, social environment, handling.

Dettmer, E.L., K.A. Phillips, D.R. Rager, I.S. Bernstein, and D.M. Fragaszy (1996). **Behavioral and cortisol responses to repeated captive and venipuncture in *C. apella.*** *American Journal of Primatology* 38(4):357-362.
NAL call number: QL737 P9A5
Descriptors: training, stress, handling.

Fragaszy, D.M., J. Baer, and L. Adams-Curtis (1994). **Introduction and integration of strangers into captive groups of tufted capuchins.** *International Journal of Primatology* 15(3):399-420.
NAL call number: QL737 O9I54
Descriptors: social behavior, fear, aggression, subordinance.

Fuchs, E., C. Kirschbaum, D. Benisch, and A. Bieser (1997). **Salivary cortisol: a non-invasive measure of hypothalamo-pituitary-adrenocortical activity in the squirrel monkey, *Saimiri sciureus*.** *Laboratory Animal* 31(4):306-311.
NAL call number: QL55 A1L3
Salivary cortisol is a non-invasive and easy-to-assess measure of the activity of the hypothalamo-pituitary-adrenocortical (HPA) system. Here we report that salivary cortisol determination can be used in squirrel monkeys (*Saimiri sciureus*) to monitor variations in HPA system activity induced by both housing and experimental conditions. Saliva cortisol assessment has several advantages over blood cortisol analysis such as stress-free frequent sampling, laboratory independence and lower costs. Therefore, this non-invasive measure can be the method of choice in primatological research projects and routine programmes related to the well-being of these laboratory animals.
Descriptors: cortisol, stress, wellbeing, laboratory primates.

Gebo, D. (1992). **Locomotor and postural behavior in *Allouatta palliata* and *Cebus capucinus.*** *American Journal of Primatology* 26(4):277-290.
NAL call number: QL737 P9A5
Descriptors: normal behavior, locomotion, howler monkey, capuchin.

Ludes, E. and J.R. Anderson (1995). **'Peat-bathing' by captive white-faced capuchin monkeys (*Cebus capucinus*).** *Folia Primatologica* 65(1):38-42.
NAL call number: QL737 P9F6
Descriptors: thermoregulation, grooming, litter, behavior.

Ludes, E. and J.R. Anderson (1996). **Comparison of the behaviour of captive white-faced capuchin monkeys (*Cebus capucinus*) in the presence of four kinds of deep litter**. *Applied Animal Behaviour Science* 49(3): 293-303.
NAL call number: QL750 A6
Descriptors: litter, laboratory primates, foraging behavior, wood chips, ground cob, wood wool, garden peat, scattered feed.

Marriott, B.M., R.W. Marriott Jr., J. Norris, and D. Lee (1993). **A semi-natural habitat for housing small, nonhuman primates**. *Journal of Medical Primatology* 22(6):348-354.
NAL call number: QL737 P9J66
Descriptors: squirrel monkeys, laboratory primates, social housing.

McGivern, L. (1994). **Small Primate Enrichment at the Calgary Zoo, Part 3: Patas and Spider Monkeys.** *The Shape of Enrichment* 3(2):8-9.
NAL call number: HV4737 S53
Descriptors: zoos, New World primates, patas monkey, spider monkey.

Spring, S.E., J.O. Clifford, and D.L. Tomko (1997). **Effect of environmental enrichment devices on behaviors of single- and group-housed squirrel monkeys (*Saimiri sciureus*).** *Contemporary Topics in Laboratory Animal Science* 36(3):72-75.
NAL call number: SF405.5 A23
Descriptors: toys, enrichment, well-being, social behavior, laboratory primates.

Stegenga, L. (1993). **Modifying spider monkey behavior with the use of environmental variables.** *Shape of Enrichment* 2(3):3-4.
NAL call number: HV4737 S53
Descriptors: *Ateles geoffroyi*, zoos, devices, behavior.

Vermeer, J. (1997). **The formation of a captive squirrel monkey group.** *International Zoo News* 44:146-149.
NAL call number: QL76 I58
Descriptors: social behavior, aggression, dominance, monitoring.

Vitale, A. (1994). **Individual differences in the manipulation of a jacket by socially housed tufted capuchins (*Cebus apella*).** *Folia Primatologica* 63(2):88-90.
NAL call number: QL737 P9F6
Descriptors: manipulanda, social behavior, jacket.

Old World Monkeys

Adams, R.J. and W.E. Britz (1997). **The baboon suite: novel method to increase the size of a baboon cage to meet the requirements for the care and use of laboratory animals.** *Contemporary Topics in Laboratory Animal Science* 36(4):70.
NAL call number: SF405.5 A23
Descriptors: guidelines, spatial behavior, Animal Welfare Act.

Brent, L. and M. Belik (1997). **The response of group-housed baboons to three enrichment toys.** *Laboratory Animals* 31(1):81-85.
NAL call number: QL55 A1L3
The behaviour of group-housed baboons was compared before and after the provision of durable cage toys. One adult male hamadryas baboon and 13 adult female olive baboons living in a large enclosure were observed after they were given seven nylon bones, seven Kong toys and seven Plaque Attackers. Observations were conducted four times per week on each subject over a 6-week period. Abnormal, cage-directed, inactive and self-directed behaviours all significantly decreased after the provision of the toys, while enrichment-directed activities significantly increased. Aggression did not differ between the no toy and toy conditions. Approximately 26% of the baboons were using the toys at any one time, and use of the Kong toys and the bones was higher than that of the Plaque Attackers.

Individuals who used enrichment structures already present were also those who used the new toys the most.
Descriptors: Papio, toys, social housing, Kong toys, bones, behavioral effects.

Brent, L. and A. Hughes (1997). **The occurrence of abnormal behavior in group housed baboons.** *American Journal of Primatology* 42(2): 96-97.

Brent, L. and D. Weaver (1996). **The physiological and behavioral effects of radio music on singly housed baboons.** *Journal of Medical Primatology* 25(5):370-374.
NAL call number: QL737 P9J66
Descriptors: radio, auditory enrichment, single housing.

Brent, L. and K.E. Long (1995). **The behavioral response of individually caged baboons to feeding enrichment and the standard diet: A preliminary report.** *Contemporary Topics in Laboratory Animal Science* 34(2):65-69.
NAL call number: SF405.5 A23
Descriptors: single housing, foraging behavior, nutrition, diet.

Buchanan-Smith, H. (1995). **The effect of food distribution on captive old world primates.** *The Shape of Enrichment* 4(1):12-13.
NAL call number: HV4737 S53
Descriptors: food predictability, group behavior, foraging activity.

Crowell Comuzzie, D.K. (1993). **Baboon vocalizations as measures of psychological well-being.** *Laboratory Primate Newsletter* 32(3):5.
NAL call number: SF407 P7L3
Descriptors: auditory stimulus, vocalization diversity, frequency.

Johann, A., S. Reichler, and S. Duecker (1996). **Experiences in the keeping of gelada baboons (*Theropithecus gelada*): Bachelor groups.** *Zoologische Garten* 66(3): 178-84.
NAL call number: 410 Z724
Descriptors: social housing, breeding strategies, behavioral enrichment, pair housed males.

Kessel, A.L. and L. Brent (1997). **Rehabilitating a rheboon *(Macaca mulatta X Papio hamadryas cynocephalus)*, from single housing to social housing: a case study.** *American Journal of Primatology* 42(2):121.
NAL call number: QL737 P9A5
Descriptors: single housing, social housing, behavior.

Kessel, A.L. and L. Brent (1996). **Space utilization by captive-born baboons (*Papio sp.*) before and after provision of structural enrichment.** *Animal Welfare* 5(1):37-44.
NAL call number: HV4701 A557
Descriptors: spatial behvior, structural complexity, baboons.

Kessel, A.L. and L. Brent (1995). **An activity cage for baboons, Part II, Long-term effects and management issues.** *Contemporary Topics in Laboratory Animal Science* 34(6):80-83.
NAL call number: SF405.5 A23
Descriptors: housing, environmental enrichment, behavior.

Kessel, A.L. and L. Brent (1995). **An activity cage for baboons, Part I.** *Contemporary Topics in Laboratory Animal Science* 34(1): 74-79.
NAL call number: SF405.5 A23
Descriptors: housing, adaptation, environmental enrichment.

Morland, H.S., M.A. Suleman, and E.B. Tarara (1992). **Changes in male-female interactions after introduction of a new adult male in vervet monkey (*Cercopithecus aethiops)* groups.** *Laboratory Primate Newsletter* 31(2):1-4.
NAL call number: SF407 P7L3
Descriptors: social housing, aggression, dominance, fear.

Neveu, H., and B.L. Deputte (1996). **Influence of availability of perches on the behavioral well-being of captive, group-living mangabeys.** *American Journal of Primatology* 38:175-185.
NAL call number: QL737 P9A5
Descriptors: perches, cage complexity, social behavior.

Reinhardt, V. (1997). **Species-adequate housing and handling conditions for old world nonhuman primates kept in research institutions.** In *Comfortable Quarters for Laboratory Animals,* V. Reinhardt, ed., Animal Welfare Institute: Washington, DC., pp. 85-93.
NAL call number: SF406.3 C66 1997
Descriptors: social disposition, semi-arboreal lifestyles, environmental complexity.

Seier, J.V. and P.W. de Lange (1996). **A mobile cage facilitates periodic social contact and exercise for singly caged adult vervet monkeys**. *Journal of Medical Primatology* 25(1):64-68.
NAL call number: QL737 P9J66
Descriptors: space, social behavior, *Cercopithecus aethiops*.

Smith, L.A. and D.S. Mills (1996). **Evaluation of the provision of a forage box to increase the normal behaviour shown by captive *Papio hamadrayas* baboons within the optimal exhibit area of their enclosure**. *Proceedings of the 30th International Congress of the International Society for Applied Ethology, Guelph, Ontario*, 1996:140.
NAL call number: SF756.7 I57 1996
Descriptors: zoos, enrichment, animal welfare, baboons.

Westergaard, G.C. (1992). **Object manipulation and the use of tools by infant baboons (*Papio cynocephalus anubis*).** *Journal of Comparative Psychology* 106(4):398-403.
NAL call number: BF671 J6
Descriptors: containers, drinking utensils, sponges, play, foraging, tool use.

Books and Conference Proceedings

American, Society Of Primatologists (1997). **Twentieth Annual Meeting of the American Society of Primatologists, San Diego, California, USA, June 27-July 1, 1997.** *American Journal of Primatology* 42(2):86-158.
NAL call number: QL737 PA5
Abstracts and posters of 178 papers from studies of primate.
Descriptors: genetics, anatomy, evolution, social behavior, cognition and learning, physiology and behavior, neurobiology and neuroscience, conservation, ecology, enrichment, well-being.

Dickie, L. (1994). ***Environmental enrichment in captive primates: A survey and review.*** Dissertation, Darwin College, Department of Biological Anthropology and the University of Cambridge, 89p.
NAL call number: QL737 P9D53 1994
Descriptors: zoos, devices, behavior stimulation, review.

European Primate Resources Network (EUPREN) (1997). *Abstracts of the Second EUPREN/EMRG Winter Workshop : The housing of non-human primates used for experimental and other scientific purposes: Issues for consideration, Rome 27.09.1996.* (Monograph online available from: http://www.dpz.gwdg.de:80/eupren/eupren.htm).
Descriptors: monitoring, housing, colony management, research applications, training animals.

Gibbons Jr., E.F., E.J. Wyers, and E. Waters, eds. (1994). *Naturalistic Environments in Captivity for Animal Behavior Research.* State University of New York Press: Albany, NY, 387p.
NAL call number: SF408.45 N38 1994
Descriptors: regulations, housing design, laboratories, zoos, psychologyical well-being.

Holst, B., ed. (1997). *Proceedings of the 2nd International Conference on Environmental Enrichment, 21-25 August 1995, Copenhagen* Copenhagen Zoo: Frederiksberg, 372p.
Descriptors: zoo primates, laboratory primates, mammals, birds.

International Primatological Society (IPS) (1993). **International guidelines for the acquisition, care, and breeding of nonhuman primates. Codes of practice 1-3** *Primate Report* 35: 3-29.
NAL call number: SF407 P7167
Descriptors: care, transport, housing, breeding.

National Research Council (1998). *The Psychological Well-Being of Nonhuman Primates.* National Academy Press: Washington, D.C., 168p.
NAL call number: SF407 P7P79 1988
Descriptors: guidelines, enrichment program elements, apes, cebids, prosimians, callitrichids, cercopithecids, research needs, sample plans.

National Research Council (1996). *Guide for the Care and Use of Laboratory Animals.* National Academy Press: Washington, D.C., 127p.
NAL call number: SF406 G95 1996
Descriptors: guidelines, laboratory animal housing, management, veterinary medicine, physical plant.

Novak, M.A. and A.J. Petto, eds. (1991). *Through the Looking Glass: Issues of Psychological Well-Being in Captive Nonhuman Primates*, American Psychological Association: Washington, D.C., 285p.
NAL call number: SF407 P7T49 1991
Descriptors: environmental enrichment, psychological wellbeing, group housing, zoos, laboratories.

Olfert, E.D., B.M. Cross, and A.A. McWilliam, (eds.), (1993). ***Guide to the Care and Use of Experimental Animals, Volume 1 (2nd Edition).*** Canadian Council on Animal Care, Ottawa, Canada, 211p.
NAL call number: SF406 G85 1993
Descriptors: social and behavioral requirements, facility design, special practices.

Reinhardt, V. and A. Reinhardt (1998). *Environmental Enrichment for Nonhuman Primates: An Annotated Bibliography for Animal Care Personnel.* 2nd ed. Animal Welfare Institute, PO Box 3650, Washington, DC 20007
Descriptors: guidelines and regulations, enrichment programs, inanimate enrichment, feeding enrichment, substrates, animate enrichment.

Shepherdson, D.J., J.D. Mellen, and M. Hutchins, eds. (1998). *Second Nature: Environmental Enrichment for Captive Animals* Smithsonian Institution Press: Washington, D.C., 350p.
NAL call number: SF408 5435 1998
Descriptors: philosophy, animal welfare, zoo animals, environmental enrichment methods.

Tomasello, M. and J. Call, (eds.) (1997). ***Primate cognition.*** Oxford University Press: New York, 517p.
NAL call number: QL737 P9T65 1997
Descriptors: behavior, psychology, motivation, preference testing.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service (1998). *Title 9, Animal and Animal Products, Part 3, Standards, Subpart D, Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates*, Section 3.81, Environmental enhancement to promote psychological well-being. 9 CFR 3.81
NAL call number: KF1681 A3C6
Descriptors: social grouping, environmental enrichment, restraint devices, exemptions.

Articles from the *Animal Welfare Information Center Newsletter*

NOTE: The following articles have been approved by USDA for inclusion in the newsletter and are in public domain. Although they have been reviewed editorially, they have not been peer reviewed. The views expressed are those of the authors.

Using Training to Enhance Animal Care and Welfare

Gail Laule (1993), *Animal Welfare Information Center Newsletter* 4(1): 2, 8-9

There is a growing trend in the zoological and laboratory animal community to recognize the value of using operant conditioning techniques as an animal care and management tool. Animals have been trained for public exhibition for centuries, but only in recent times has the versatility of training been explored to any appreciable extent. The result has been a variety of benefits for animals, caretakers, veterinarians, and others concerned with the welfare of captive animals. This new interest in training has grown concurrently with the interest and attention surrounding the issue of psychological well-being. I don't believe this is an accident. In fact, a strong case can be made that training, from a physical and psychological perspective, is "good" for animals. However, I am referring to a specific type of training.

Positive Reinforcement

As consultants, we advocate and teach positive reinforcement training. This type of training relies on the voluntary cooperation of the animal to succeed. Unlike some methods, positive reinforcement training does not require food deprivation. Although animals are reinforced with rewards for the desired response, they are fed their daily allotment of food and rewards for training utilize that diet or extra treats. Operationally, it means that we exhaust the positive alternatives before any negative reinforcement is used. On the rare occasion when an escape/avoidance technique is necessary, it is used minimally and is balanced by a greater proportion of positive reinforcement. Punishment is only used in a life-threatening situation for a person or animal.

Positive reinforcement training is truly universal. Operant conditioning provides the tools; how the trainer uses them provides endless opportunities. We have used these techniques with marine mammals, great apes and other primates, canids, felids, ungulates, and others. The basic techniques remain the same; however, adjustments are made for different species, differences among individual animals, the environmental and social situations they are in, and the specific operational objectives.

If training has a down side, it is twofold. First, training is a skill that takes time and practice to develop. Poorly planned and implemented training can definitely create more problems than it will solve. Secondly, training is time and labor intensive, particularly in the initial stages of a project. However, if viewed in the longterm, these drawbacks can be turned into advantages. Having caretakers with training skills may help alleviate future problem behaviors. And, training results, such as animals voluntarily cooperating in veterinary procedures, ultimately are time and labor saving.

For example, in a pilot program being conducted at the chimpanzee breeding facility at the M.D. Anderson Cancer Center Science Park in Bastrop, Texas, urine collection training is being pursued with all breeding-age female chimps (9). Currently, urine from these females is collected once per cycle by separating the female from her group and waiting for her to urinate, which may take minutes to hours. Training a chimp to urinate on cue may initially take several hours of time over several weeks. However, investing those few hours to achieve reliable collection in less than 10 minutes realizes tremendous time savings over the life of that animal. With urine collection simple and reliable, other research or medical opportunities also become possible.

Training offers a wide array of benefits for animals and personnel. Through the process of desensitization, animals are conditioned to voluntarily cooperate in veterinary procedures that can be negative events. Training sessions are spent pairing positive reinforcement with these negative events, ultimately making them less negative, less scary, and less stressful. Also, when animals voluntarily cooperate, anesthesia becomes unnecessary, and the frequency of these behaviors can be increased for use on a preventive basis. Another, more subtle benefit is the increase in choices and control that trained animals' experience. Restraining an animal for a procedure, or having an animal voluntarily cooperate during the procedure without restraint, are two very different events, for both the animal and personnel. One could argue that allowing animals greater control over their lives contributes to psychological well-being.

In practice, skillful use of training techniques has resulted in animals that voluntarily move between areas or cages in a reliable and timely manner; marine mammals that voluntarily allow routine blood, stomach, fecal, urine, and blow hole samples to be taken; and primates that cooperate in physical examinations including offering body parts for inspection and treatment of wounds, tolerating a stethoscope and thermometer, and allowing blood sampling and injections (7, 11). Thus, the potential is there to condition individuals of many species to tolerate similar procedures.

Aggressive Behaviors

Training has proven to be effective in addressing aggression problems in social groups in a variety of species. One study documented the reduction of aggressive behavior of one male chimpanzee toward other group members during feeding time (1). By reinforcing the dominant animal for allowing the others to have their share of food and attention, both aggressor and subordinate animals benefitted. He received special treats and attention for his cooperation, and the others were able to receive and consume their allotted food in a less stressful environment. We call this technique "cooperative feeding" and have used it successfully over the years in many situations, including working pairs of male sea lions together, integrating subdominant dolphins into groups, and preparing and implementing introductions with gorillas and other primates (7, 8). It was also one technique employed with a group of drill baboons to increase overall positive social interactions and affiliative behavior within the group (3, 4).

Positive reinforcement training with elephants, implemented through a system we call "protected contact," has resulted in a dramatic reduction of aggressive behavior toward keepers (5, 10). In this type of training, where trainers work with the elephants through shields or barriers, aggressive behavior is not punished, but simply ignored. At the same time, cooperative, non-aggressive behavior is reinforced when it occurs. The system does not rely on social dominance or escape/avoidance techniques, but on the voluntary participation of the elephant. In fact, in 365

protected contact training sessions with four elephants, the animals chose to work 99 percent of the time. The result is an elephant that is motivated to cooperate with, rather than act aggressively toward, the trainer.

Stereotypic Behaviors and Enrichment

Training offers techniques and strategies to address neurotic or stereotypic behavior. By training a behavior that is incompatible with the problem one, or a new behavior to replace the undesirable one, or by simply raising the amount of activity and stimulation for the animal, problematic behavior can be reduced or eliminated. In the case of one bottlenose dolphin, training strategies were successfully employed to reduce the incidence of four behavioral problems: swallowing of foreign objects, frequent regurgitation, biting trainers, and inability to integrate into a social group (6).

In a recent study conducted at the M.D. Anderson chimp facility, the issue of training as enrichment was explored. Preliminary results indicate that training offers some benefits for animals that are related to psychological well-being. For example, three significant positive changes occurred during training: reduced self-directed behavior, reduced inactivity, and increased social play (2). To my knowledge this is the first study of its kind, and we intend to do more.

Positive reinforcement training is gaining stature among animal managers as a useful tool for enhancing animal health care and husbandry needs. It is also more versatile and multi-functional than may initially be perceived. Whether the situation involves a solitary animal with limited sensory stimulation, or a group of animals in the most "naturalistic" environment imaginable, well planned and implemented training has a place.

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Acknowlegements:

Work at the M.D. Anderson facility was supported by the NIH/DRR grants R01-RR03578 and U42-RR03489.

The Use of Behavioral Management Techniques to Reduce or Eliminate Abnormal Behavior

Gail Laule (1993), *Animal Welfare Information Center Newsletter* 4(4): 1-2, 8-11

In the continuing quest to provide optimal care for animals in captivity, the issue of abnormal behaviors is a cause for concern. Whether we call them stereotypic, neurotic, nonadaptive, or atypical, behaviors of this kind are problematic. The consequences of abnormal behaviors range from unpleasant sights for the zoo visitor, as in the case of coprophagy in a resident gorilla, to serious health problems for the animals themselves, such as self-biting in a singly housed rhesus macaque. Animals exhibit abnormal behaviors in a variety of social and environmental contexts: naturalistic and purely functional, large social groupings and singly housed, enriched and sterile. No zoo, laboratory, or breeding facility, it would seem, is exempt. Neither is any species. One approach to dealing with abnormal behavior is through the use of behavioral management techniques. Behavioral management refers to the combined use of positive reinforcement training and environmental enrichment techniques and strategies.

A variety of strategies to address abnormal behavior have been reported, and they tend to fall into three main categories: feeding manipulations including types of food and methods of feeding (Ruempler, 1991; Bloomsmith, 1988); enrichment strategies including environmental manipulations and provisioning of toys and apparatus (Bryant, et al., 1988; Fried, et al., 1993); and social manipulations (Reinhardt, 1987). These various strategies have produced mixed results. Unfortunately, even in the best case scenarios, abnormal behaviors are most often reduced, not eliminated. References to the use of training as an intervention for abnormal behavioral problems are still fairly rare (Morgan, et al., 1993; Kirtland, 1993).

There are good reasons why efforts to reduce or eliminate abnormal behavior have limited success. First, the causes of abnormal behavior are often subtle and complex, and tracking down how and why the problem began can be a task worthy of Magnum P.I. Second, the relationship between real or perceived stressors and abnormal behavior can result in the behavior evolving into a functional coping strategy for the animal (Gould and Bres, 1986). Once utilized as a coping strategy, these behaviors are self-reinforcing and extremely tenacious in nature. Finally, problem behaviors often occur when people are not present, limiting the opportunity for direct intervention.

So, given these caveats, what benefits can behavioral management techniques offer personnel dealing with abnormal behavior problems? Probably the biggest benefit is that they provide a means to systematically address a variety of behavioral issues, including abnormal behavior. In its purest form, it is a practical exercise in the scientific method. The following steps illustrate the process.

1. Collect data. This is the question-asking phase of the process. Discovering when, where, and how a behavior occurs, and in relation to what, will ultimately lead you to a best guess as to why it occurs, and provide the basis for effective intervention. Relevant information includes:

- When does the behavior occur?;
- Under what circumstances?;
- Is there a pattern?;
- What outside factors affect the behavior such as feeding or cleaning schedules,

medical procedures, the presence of unfamiliar people, activities involving animals other than the target animal, the presence or absence of cage or exhibit furniture, and so on?; and

- What impact do social dynamics have on the behavior such as the social status of the target animal, the lack of compatible conspecifics, the presence or absence of specific group members, and the level of positive and agonistic interactions within the group?

The more objective the data, the better. Formal behavioral studies are ideal, but simple charts for when and how a behavior occurs, filled out by keepers or caregivers as they go about their daily activities, improve the quality of the information.

2. Develop a hypothesis. After a careful discovery process, a list of potential causes and contributing factors should be developed. Then, it's possible to make a guess as to why the abnormal behavior is occurring. For example, we could hypothesize that disruptive behavior by a chimpanzee, like throwing feces or trying to grab caregivers, is an attention-seeking behavior, whether the resulting attention is positive or negative. Or, we could guess that social pressure by the dominant male coupled with a predictable feeding routine are the underlying causes for a low-ranking sea lion regurgitating for extended periods of time after regularly scheduled feeds. The importance of a well-developed hypothesis is that it is the starting point from which your intervention plan is developed.

3. Identify specific behavioral goals and initiate training and enrichment strategies. With a clear hypothesis, you can design and implement an intervention plan to address targeted behaviors. The best way to do this is from a behavioral management perspective. For example, by definition, reinforcement increases the likelihood that a behavior will recur. In the case of the primate that utilizes disruptive behavior as an attention-seeking measure, look at the situation and determine where the reinforcement is occurring. More than likely, when the animal uses the disruptive behavior it receives a great deal of attention, probably negative, but attention none the less. Indeed, "displays" put on by frustrated humans who have just been "had" can be quite entertaining. But what is perhaps more relevant is what happens when the animal is *not* disruptive. Chances are the human walks right by.

According to the hypothesis, human attention is the reinforcement the animal is seeking. So, when are the rewards occurring, and what are the results? Ironically, feces throwing and arm grabbing are being continuously reinforced, while non-aggressive cooperation is not being reinforced at all. The resultant behavior is consistent with the reinforcement pattern. The intervention strategy is then two fold. First, reinforce the animal when it is *not* disruptive. Stop for a moment, say a few words, offer a small treat or favored toy, *reinforce* cooperative behavior. Second, do not reinforce the disruptive behavior. Turn around, count to 10, or walk away, and then look for any opportunity to reinforce the desirable behavior. This is a straightforward, simplified example of the problem-solving process. However, it is amazing how often this pattern is repeated in a variety of contexts with similar results.

In the case of the regurgitating sea lion, strategies must be devised to address both contributing factors identified in the hypothesis. First, the socialization problem can be dealt with by utilizing a training technique called "cooperative feeding." Operationally, it entails reinforcing two events simultaneously: dominant animals are reinforced for allowing subdominant animals to work and receive food or attention, while the subdominant animals are reinforced for being "brave" enough

to work and accept food or attention in the presence of these more aggressive animals. In this case, training would focus on the target animal and the dominant male. Second, the feeding schedule should be altered to make it less predictable. If times of feeds are on a set schedule, extra cooperative feeding sessions should be added in-between. Finally, enrichment strategies should be implemented in-between feeds to provide activity options other than regurgitation.

4. Check the results. There are no pat answers or guarantees in dealing with behavior, problematic or otherwise. It is dynamic in nature, and so much of what we do is guesswork. However, there are two processes that increase the likelihood of making the right guesses. First: the quality and extent of information gathered prior to initiating any work--the data collection phase. That, coupled with knowledge of the individual animal, makes a carefully developed hypothesis an *educated* guess. Second: is an on-going evaluation of information you get back from the activity. Is a particular strategy achieving the results that are anticipated? If the answer is yes, it's a good bet to stay with the current strategy. If the answer is no, it's time to reevaluate and perhaps try something else.

5. Adjust strategies if necessary. It is critical to maintain a realistic expectation of results, so a strategy is not abandoned too quickly, or sustained too long. If that occurs, the result can be a great deal of frustration and confusion for the animal, which may worsen the problem. When one approach has been tried for a sufficient length of time (a critical judgment call) without the desired results, try something else. Then, check results again, and continue to adjust strategies as necessary. The bulk of behavioral work is comprised of steps 4 and 5. In tough cases, it may be necessary to try several different strategies before one works. Or often, it will be a combination of strategies that finally achieves the desired results. That's why good behavioral management skills include a heavy dose of creativity, innovation, and most important, flexibility.

Most of the actual work in this area has been conducted with marine mammals and primates. The following are some specific examples of how behavioral management strategies have been used to decrease or eliminate abnormal behaviors.

Over a period of 7 months, a pilot behavioral project was conducted at the Los Angeles Zoo with a resident group of drill baboons (Desmond, et al., 1987). The primary goal of the project was to increase positive social interactions and reproduction among the group members. There was also concern about a sub-adult male who had been introduced to the group 6 months previously and was shunned by them. He often appeared stressed, and exhibited some abnormal behavior. Finally, due to the social dynamics within the group, he and other subdominant animals were inaccessible to the keepers for handling or husbandry purposes.

A thorough information-gathering process was conducted, which included interviews with relevant personnel and assessment of behavioral observation data conducted on the group for the previous 2 years. Based on this information, a hypothesis was formulated. The hypothesis was that a long-term moderate state of sensory deprivation had existed in the exhibit. This shortage of stimulation had resulted in subtle competition among group members which, in turn, inhibited breeding, other positive social interactions, and interest in interacting with the environment. It also contributed to the presence of problematic behaviors by all group members including fence nibbling, self-biting, and examining and eating feces.

Based on this hypothesis, the following behavioral goals and strategies were developed:

1. Increase overall sensory stimulation of the group through regular training sessions.

2. Increase positive social interactions in the group by cooperatively feeding animals in different dyads and triads, reinforcing them for eating and relaxing in close proximity to one another.

3. Increase keeper access to individual animals by establishing feeding stations and targets to control food intake, the movement of animals, and achieve voluntary separation.

Although reducing abnormal behaviors was a goal, the training strategies were developed to address the underlying *causes* of these behaviors - insufficient sensory stimulation, and socialization problems. Operationally, the young male was often paired with an adult female for cooperative feeding sessions. She was reinforced for "staying" while he was given food and personal attention. He learned to gently touch the trainer's hand and arm, approximating grooming. He slowly became less nervous and agitated when eating with the female, and increasingly more relaxed. Prior to this project, he had been observed biting his leg in a manner and frequency that indicated the potential onset of neurotic behavior. Keepers familiar with the exhibit reported a significant reduction in the observance of the behavior throughout the training project.

Documented results showed significant increases in all forms of positive, social interactions during and following the project (Cox, 1987). Reduction in all forms of abnormal behavior was also achieved.

Another project illustrating the process of addressing abnormal behaviors involved a captive-born Bottlenose dolphin named Pepe (Laule, 1984). Living with a couple of other young animals, two separate attempts were made to integrate him into a larger social grouping of show animals. These attempts were unsuccessful, and in the process he developed several abnormal and problematic behaviors. These included an erratic appetite and attention span; biting people during unstructured play sessions; habitual regurgitation; and chronically swallowing objects that fell into the water.

In researching Pepe's situation and history, several factors were identified which may have contributed to the development of these problem behaviors. First there were health-related problems, including the presence of small ulcers which could have affected his appetite and energy level. He had also sustained an injury to his peduncle area, which caused occasional swelling and which was under constant scrutiny. This was later diagnosed to be osteomyelitis and a source of his chronically high white blood cell counts.

Another factor was his submissive behavior. Whenever he was introduced into the larger social group, despite his greater size, Pepe always aligned himself with the subdominant males and quickly became the lowest ranking animal. In that weak position, pressures were placed on him that he was apparently unable to cope with.

Differences in training regimen from one condition to the other may have also been a factor. These changes included the loss of his one primary trainer and subsequent replacement by four new individuals. Behavioral charts indicate he was worked inconsistently, less often than before, and with less challenging work. In a period of almost 2 years, he learned only one new behavior while losing several others. He also received less personal attention.

One last factor concerns the age at which Pepe was separated from his mother, and the impact that may have had on his subsequent development. Compared to the other five dolphins born at the park, Pepe's separation from his mother, at 18 months, was at a substantially earlier age. The average age of the other five animals was 29 months, with the youngest being 26 months and the oldest 33 months.

Although I found no definitive research or conclusions on optimal age of separation, Herman notes, in his book *Cetacean Behavior*, "Close affiliation between the newborn and mother continues for an extended period of time and dependency may persist even into adulthood" (Herman, 1980). Whether this had an impact on Pepe's later problems is uncertain. Nonetheless, it is noteworthy, in light of the extensive research done by John Bowlby on early separation of young children from their mothers and the far- reaching effects this has on personality and behavioral development (Bowlby, 1973).

Once the potential causes and contributing factors were identified, a variety of strategies were employed to address each of the problematic conditions. Because of his delicate health, he was the first dolphin to be trained to present his tail flukes for blood sampling, and to accept a stomach tube and fecal tube insertion for sample collection. With his voluntary cooperation, it was easier and less stressful to perform these procedures and monitor his health on a regular and frequent basis.

To help stabilize his eating habits, and to curb his throwing up, different feeding schedules were employed. For a period of 2 weeks, Pepe was fed twice nightly to increase his appetite and weight. Little change was noted. Next, a schedule of eight feeds per day was begun which continued for approximately 2 months. His normal diet was fed in small amounts over the course of the day, with at least three of the feeds being training sessions. Accurate charts were kept, listing the time of day, number of pounds fed, and the amount, if any, of regurgitation seen. This provided a clear picture of Pepe's eating and regurgitating habits, and the evidence of change when it did occur. Specific intervention for the regurgitation included using a verbal "no" and short time out when Pepe would regurgitate during or after his feeds. Extra time was spent with him immediately following a feed, during which time he was rewarded with attention and play for not regurgitating.

To address both the problem biting and his habit of swallowing foreign objects, desensitization work was initiated to train him to allow us to touch his mouth, tongue, and teeth, without biting. At the same time, he was trained to retrieve safe objects like paper cups or paper towels, and then let us open his mouth and remove the objects from his mouth or throat. Third, water work was begun with Pepe, reinforcing him for gentle play and non-biting behavior. The reinforcement was high at first, then slowly reduced until reinforcement was no longer necessary at all.

To assist in his socialization, he was specifically worked with each of the dominant animals. Pepe was encouraged and rewarded for participating in these sessions, while the dominant animal was rewarded for allowing him to do so. Conversely, if Pepe did not work, reinforcement was withheld from the other male until he did.

Other behavioral strategies included maintaining consistency of trainers, keeping the number of daily training sessions high, and balancing sessions between individual work and work with other animals. Special care was also taken to provide Pepe with a lot of personal attention and support.

Finally, Pepe was moved to a different show area with four other animals. From the first day, consistency in trainers was maintained by having myself or another familiar trainer with him everyday. For the first 2 weeks, we spent all of our extra time with Pepe, just sitting with him, rubbing him down, or playing. For 2 months, we were present during shows and training sets to work exclusively with him. Concurrently, the other animals were reinforced for allowing Pepe to work, and any positive social interactions were reinforced.

The results of these strategies were quite encouraging. Pepe was successfully integrated into the show. Socially, he appeared comfortable, interacting with all of the other animals and developing a strong bond with the female pilot whale, each displaying imitative behavior learned from the other.

His biting stopped completely. He would allow us to open his mouth and remove any objects. Rubbing his mouth and tongue became his favorite tactile behavior. In fact, Pepe's overall responsiveness to people increased tremendously. He would now seek attention and interact gently and non-aggressively. His retrieval work improved, so that he would voluntarily return an item he found to the trainer, or retrieve a specific object we pointed to.

His throwing up almost completely disappeared, with only an isolated occurrence being noted. His appetite and attention span, although occasionally erratic, improved greatly overall. He maintained his repertoire of behaviors and continued to learn others.

The examples I described were ambitious attempts to address and resolve a complex set of problematic behavioral issues. These efforts required an investment of time and effort that may not be practical or possible in many situations. However, what is applicable to every situation is the *process*. It doesn't have to be complicated and tedious, but to some degree it has to be done. Abnormal behavior is not a simple problem, and there are rarely simple solutions. The greatest success in dealing with abnormal behavior will come from addressing the causes of the problem, not just the problem behavior itself. With that approach, there are often simple things that can be done to positively impact the situation to some degree (Bayne, et al., 1993).

Behavior is an acknowledged indicator of well-being (Petto, et al., 1990). When we strive to provide optimal care for captive animals by providing for their physical and psychological well-being, reducing or eliminating abnormal behavior is an issue that cannot be overlooked or shortchanged.

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Environmental Enrichment for Captive Wildlife Through the Simulation of Gum Feeding

Kathy Kelly (1993), *Animal Welfare Information Center Newsletter* 4(3): 1-2, 5-10

Introduction

Exudativory, or the use of plant gums, saps, resins and occasion- ally latex as a food source in an animal's diet, has been increasingly documented by field studies performed during the past 40 years (Nash, 1986). Animals known to eat plant exudates are found among the prosimians, marmosets, tamarins, lemurs, squirrels, marsupials, old world primates, and birds (Fleagle, 1988; MacDonald, 1984; Rylands, 1984; Post, 1983; Smith, 1982; Wrangham, 1981; Bearder, et al., 1980; Charles-Dominique, 1977; Hausfater, et al. 1976; Izawa, 1975; Kilham, 1975; Tate, 1973; Radman, 1969). A literature search done in 1990 resulted in documentation of exudate-feeding in 45 species of animals (see table 1). However, the degree of dependency of animals on this food source is variable. For example, plant exudates are the major component of the natural diet of the Fork-marked lemur (Phaner furcifer), Pygmy marmoset (Cebuella pygmaea) (Fleagle, 1988; Hershkovitz, 1977; Nash, 1986), and prosimians (Charles-Dominique, 1980; Oxnard, et al., 1990). These animals are considered "primary" gum-feeders based on their morphological, anatomical, physiological, and behavioral adaptations (Fleagle, 1988). "Secondary" gum-feeders are species that feed on plant exudates as a response to decreased fruit and flower availability, or climatic changes such as wet or dry seasons. Another factor that influences the degree to which animals rely on plant exudates is whether these exudate sources are water stressed, which results in low exudate production (Garber, 1984a; Nash, 1986; Lacher, et al., 1984). Exudate use also includes animals that ingest them opportunistically when they are found and animals that ingest exudates coincidentally when they eat, or perforate, bark down to the cambium layer during insect- or browse-feeding.

Between March 1988 and September 1990, I was a member of a behavioral research project at the Small Mammal House, National Zoological Park (NZP), Washington, D.C. Our objective was to apply the information, documented by field research about gumivory, to the captive management of our Pygmy marmosets, Black-tailed marmosets (Callithrix argentata melanura), and Geoffrey's marmosets (C. geoffroyi). We also offered gum arabic to other animals in the collection such as Lion tamarins (Leontopithecus spp.), Goeldi's monkey (Callimico goeldi), Low's squirrel (Sundasciurus lowi), Sugar gliders (Petarus breviceps), Prevost's squirrels (Callisciurus prevosti), and Cuban hutias (Capromys pilorides). All of these animals, except for the Sugar gliders, were on exhibit during our study. Since our experience is with gum-feeding, I will use the term gumivory, or gum-feeding, to be synonymous with the term exudativory. The following information presents the results of our research experiences, gained knowledge, and the unexpected side benefits we obtained from simulating gumivory in captivity.

BIOLOGY OF GUMIVORY

Anatomical Adaptations

Generally, animals that use plant exudates are small bodied, have a high metabolism, and are incapable of storing large amounts of fat. "Primary" gum-eaters have most, or all, of the following

traits: small body size, clawed digits (for vertical clinging at gum sources), long procumbent or semi-procumbent incisors complimented by short lower canines (providing a level gouging/scrapping surface), loss of enamel on the lingual side of the lower incisors complimented by honing upper incisors (providing a "sharpening" effect that permits gouging or scraping abilities), a V-shaped configuration of the mandibular arch, a long tongue (to reach gums within the plant bark), and an enlarged cecum (to allow for fermentation of the gums) (Fleagle, 1988; Coimbra-Filho, et al., 1978; Rosenberger, 1978; Hershkovitz, 1977).

Nutritional Factors Associated With Gum-feeding

Gums are a high-energy food source composed mainly of water, complex polysaccharides, calcium, and trace minerals (iron, aluminum, silicon, potassium, magnesium, and sodium) (Nash, 1986). Calcium is important to all animals, especially female callitrichids (tamarins and marmosets) which commonly give birth to twins twice a year. It is during the lactation period that the females are usually impregnated by the male. Therefore, they are developing fetuses while nursing their fast-growing infants, resulting in an increased calcium demand. The calcium-to-phosphorus ratio is high in gums which offsets its ratio in insects, which is low. Because all known wild gumivores also include insects in their diet, combining the two, in captivity, may approach a desired nutritional balance and is recommended to avoid the possibility of nitrogen loss and the loss of protein from the body (Nash, 1986; Garber, 1984a; Sussman, et al., 1984; Coimbra-Filho, et al., 1978; Moynihan 1976).

Ecological Factors Associated With Gum-feeding

Gums from woody plants are reportedly available year round and are constant in their location (Bouchardet de Fonseca, et al., 1984; Ramirez, et al., 1978). This aspect allows marmosets, which are capable of eliciting gum flow, to be non-seasonal breeders and to subsist in small home ranges. Some tamarin species have been noted by field researchers to travel in association with marmosets and parasitize their gum sites.

It has been suggested that gums are an integral link in the food chain of gumivores (Soini, 1982). Some insects (moths, butterflies, ants) are attracted to the gum sites, while other insects simply get stuck in the sticky substance. These insects are often preyed upon by lizards and frogs. Gum-eaters prey on both animals, which reduces the amount of time and energy exerted in procuring animal protein in their diet. Gum-feeding typically occurs at the lower levels of the forest canopy (about 3 meters from the ground) where fruits and flowers are usually absent (Ramirez, 1978; Moynihan, 1976). The ability to subsist at this level lessens competition with other forest animals, which are predominantly frugivores or foliavores (Fleagle, 1988).

Gum-feeding is more than just another feeding strategy. It is the merging of the nutritional, ecological, behavioral, and evolutionary traits which allows species that are capable of using this resource to coexist in the wild.

Captive marmosets will instinctively gouge holes in exhibit furniture, despite the fact that they do not receive a food reward. Offspring of captive-born parents also gouge wood throughout their lives. The instinct to retain this behavior is so strong that infant marmosets in captivity demonstrate substrate "mouthing" behavior--the prerequisite to gouging behavior--as early as 3 weeks

of age in Pygmy marmosets and at 5 weeks in Black-tailed marmosets (person. observ.).

NZP Research

In 1988, we began our research project by offering gum-feeders based upon McGrew's suggested artificial gum-feeder for marmosets (McGrew, 1986). These gum-feeders consisted of eight dowel segments with four drilled-out circular cavities (gum reservoirs) that were stacked onto a threaded, metal rod, secured with wing nuts, and wired onto the existing cage furniture. The marmosets not only accepted and fed from these gum-feeders, but became possessive of them when replacement was needed. Although the artificial feeders functioned, there were technical drawbacks. They required shop fabrication and needed to be soaked in water weekly because the dowel was very hard and dry. They were also unnatural in appearance, time-consuming to fill (filling with gum, feeder assembly, and installation of four feeders took approximately 2.5 hours per day), and they required weekly replacement. We abandoned this type of gum-feeder after 2 months and substituted natural branches for the dowel (gum reservoirs were simply holes drilled into the branch). Not only was this type of feeder accepted but it served as additional cage furniture that functioned as pathways and perches for the animals. This type of feeder provides the animals with a naturally textured substrate, is readily obtained, requires no assembly, and if "hard wood" is used, needs less frequent replacement (our hard wood feeders have been in place for 5 years). Filling these feeders can be accomplished in 5 to 10 minutes (Peterson, et al., 1988).

The following year we expanded the natural-branch idea to the use of floor-to-ceiling-length tree limbs, oriented in vertical and diagonal positions. This additional length of the feeders allowed us to provide eight feeding sites (gum reservoirs) in three locations on each feeder -- near the top, in the middle, and near the bottom.

Using checksheets and 45 trained volunteer behavior watchers, we observed for signs of differences in vertical versus diagonal preference, hard wood versus soft wood feeders, and preference of depth and dimension of drilled holes.

We also experimented with presenting the gum arabic/water solution in a rodent water bottle with a sipper tube (do not use tubes with a ball-bearing). We offered this modified gum-feeder in three ways: 1) inserted through one of our feeders, with the stem protruding; 2) hidden inside a piece of cork bark, with the stem protruding; and 3) affixed directly onto the wiring of a holding cage. The third method could be used for an animal that has been separated for health reasons or because of preshipment. It could also be used for enrichment in a laboratory situation where individual housing may be necessary for compliance with research protocol. Our objective was to make the gum available ad libitum, in hopes that the marmosets would teach us how often they use it.

Results of Providing Natural Wood Feeders to Marmosets

Data analysis (850 observation hours) revealed that the Pygmy marmosets (1.1.2, 1.1, 1.1) [Ed. Note: the first digit indicates the number of male animals, the second digit indicates the number of females, and the third, if present, indicates that the sex is unknown] used all gum sites on all feeders provided to them regardless of position, type of wood, or depth and dimension of drilled gum holes. The Black-tailed marmosets (1.1.2) demonstrated a preference for gum sites that were mid to upper level on vertical feeders. The Geoffrey's marmosets (1.1) used all feeders and feeding sites provided to them regardless of orientation, type of wood, or hole dimension.

Marmoset Behavioral Responses

The Pygmy marmosets shared feeders and even feeding sites without conflict. Over time, the Black-tailed marmosets became territorial over the feeders and a pronounced hierarchy system emerged within the family. The male Geoffrey's marmoset "hung back" and allowed the female first access to the gum sites. This behavior has been documented in some species of wild prosimians (Charles-Dominique, 1977).

One observation consistent among our marmoset species was that the use of "soft wood" feeders stimulated more scent marking and gouging behavior which resulted in marked damage to the feeders as well as to the existing cage furniture.

By providing gum feeders in vertical and diagonal orientations, we had unintentionally provided the marmosets with the opportunity to employ their widely recognized abilities as vertical clingers and leapers. When eating gum from the feeders, the marmosets often fed from an upside-down, clinging position -- a posture not seen at other times. Gouging on feeders and eating gum from them required the marmosets to use muscles that are not used when locomoting quadrupedally on horizontal vines and branches--the typical exhibit furnishings provided in captive settings (Newman, et al., 1990; Garber, 1984b).

Benefits Resulting From Providing Gum-feeders to the Marmosets

1.) Increased animal activity level: The marmosets immediately come down to the feeders while the keeper is injecting the gum into the drilled holes via a syringe. They would also return to the feeders, at various times in the day, to scrape off and eat the dried gum overflow that adhered to the feeders' bark. This replicates the feeding pattern of their counterparts in the wild (Fleagle, 1988).

2.) Increased animal visibility: The Pygmy marmosets in all three exhibits will come within 2-3 inches of a caretaker while the gum is injected into the drilled holes, while the four Black-tailed marmosets and both Geoffrey's marmosets will eagerly eat the gum arabic directly from a syringe (Newman, et al., 1990). This simplifies the task of performing daily head counts of these animals.

3.) Close proximity to exhibit animals allows for health observations: Since the marmosets either eat the gum directly from a hand-held syringe or come within inches of the caretaker, we have been able to detect early signs of pregnancy and detect and monitor minor injuries (cuts, scratches) and dental problems that do not require immediate treatment. We use the gum-filled syringe to encourage our young Black-tailed marmosets to stretch out for sex confirmation. We also used the gum-filled syringe to administer antibiotics to our adult, female Black-tailed marmoset who was diagnosed with a flagyl parasite infection (Figure 3). She refused her medication, even when hidden in her favorite food items, but accepted it when it was mixed into the gum arabic solution (Kelly, et al., 1989) and offered to her in the familiar syringe. Feeding gum arabic has proven to be a useful tool for animal caretakers to keep abreast of their animals' general health. The aspects of close proximity to the animals with its resulting observational benefits can be performed without physical manipulation or stress to the animals (Newman, et al., 1990).

4.) Visitor experience enhancement: Throughout our study, all of the gum-feeders were positioned near the public viewing side of each exhibit. The public responded to our gum-feeding project with

interest and enthusiasm, and countless questions about the animals. It is exciting for zoo visitors to see a captive animal active and interacting with its environment. Other visitors appreciated the opportunity to get "close-up" photographs of the animals engaging in a natural behavior.

Gum-feeding Results in Lion Tamarins, Goeldi's Monkey, Marsupials, and Rodents

In the summer of 1989, we offered floor-to-ceiling-length wood feeders to a mixed bachelor group of Golden Lion tamarins (Leontopithecus rosalia) and Golden-headed Lion tamarins (L. r. chrysomelas) that were exhibited outdoors. The feeders became a source of interest and stimulation for the tamarins. Use of these feeders again illustrated species-specific behavior responses.

The Golden-headed Lion tamarins stripped off the bark over the gum sites to gain access to the gum that had been injected into the holes, whereas the Golden Lion tamarins were observed probing the gum-filled holes and then eating the gum from their fingers. The Golden-headed Lion tamarins also returned to the feeders later and stripped off additional bark from over the gum holes to gain access to any gum residue. At no time did we observe conflicts between the tamarin species over the gum (Kelly, et al., 1989).

When we injected the gum into a wide, circular depression on one of the feeders, both species of tamarins were observed using their cupped hand to scoop up the gum and eat it. This is the same method used in the wild to obtain rainwater from the cups of bromelids.

Our trial with Goeldi's monkey was limited to an individual female that was housed with our Black-tailed marmosets during our initial study in 1988. She did taste, and, on occasion, eat some of the gum, but she did not demonstrate strong attraction to it as did the marmosets and tamarins. We believe she was simply mimicking the Black-tail's responses to the gum. We have since learned that wild Goeldi's are not known to eat gums from woody plants, but do eat a sticky gum substance found on seed pods.

We were disappointed by our results with the Low's squirrel and the Sugar gliders. We offered a natural wood gum-feeder to a Low's squirrel and although the gum always disappeared, we never actually saw the squirrel using the feeder. It has been our experience that Low's squirrels are typically shy and secretive. The Sugar gliders (family group of five), however, stripped off large areas of bark from the feeders but ignored the gum sites. Further literature searches suggest they were probably searching for insects under the bark. Providing natural branches to Sugar gliders, even without gum, provides a stimulus to them which increases their activity level. Although both of these species are documented gum-eaters (MacDonald, 1984; Smith, 1982), the types of gum utilized by animals vary among species because of differences in geographic ranges and environmental factors. We used acacia gum extract in our trials which may not be the type of gum eaten by Low's squirrels and Sugar gliders.

One pair of Prevost squirrels in our study ate gum from the feeders as well as directly from the syringe. We do not place emphasis on their acceptance of the gum-feeders since this particular pair of squirrels were hand-raised and seek human interaction. The other pair of Prevost squirrels (parent-raised) in our study showed little-to-no interest in the gum or the feeders.

The responses of the Cuban hutias were surprising. Our four hutias were recently acquired,

wild-caught animals. We do not have any documentation of gum-feeding in this species, but based on our theory that wood-eating species ingest gums, we offered the gum to them. The hutias, especially the females, ate the gum directly from the syringe but at no other time would they allow us close proximity to them. We have noticed that the females in all the trials, especially when pregnant, are usually the first animals to come for the gum.

Although we did not intentionally include Acouchis (Myopracta pratti) in our gum acceptance trials, we learned that some acouchis will eat gum. The pair of acouchis housed in our mixed Geoffrey's and Pygmy marmoset exhibit began eating any gum that accidently landed on the floor. One of these acouchis would eat the gum directly from the syringe and would stand up on its hind legs, waiting to be fed the gum.

All of the above animals, except for the Low's squirrel and the Sugar gliders, would come surprisingly close to keepers feeding gum or they would accept hand-feeding via the syringe. This provided us with the same side benefits previously listed for the marmosets.

We also placed natural wood gum-feeders in some of our indoor mixed-species exhibits. The feeders became a source of interest and activity to the gum-eating species as well as to the non-gum-eating species. Curiosity was stimulated and intra- and inter-species activities resulted, thus creating a more interesting environment for the animals.

Discussion

Our research project has shown that natural branch gum-feeders can be used to simulate gumivory in captivity for a variety of animals. Use of natural branches/tree limbs is an inexpensive, readily available, and low maintenance method of providing environmental enrichment in an artificial setting. Simulating gumivory in captivity can be accomplished with minimal time investment and energy demand on the part of animal caretakers.

Modern zoos are attempting to exhibit animals in naturalistic settings. Ideally, the goal should be to exhibit animals in a naturalistic setting that stimulates behavioral interactions between the animals and their environment. We feel our natural branch gum-feeders help accomplish this goal.

When captive environments lack stimulus, animals are deprived of the opportunity to engage in some of their natural behaviors, which may be replaced by atypical behaviors characterized by excessive inactivity, grooming, and/or sleeping (Schoenfield, 1989). Duplicating natural habitats as much as possible in captivity encourages animals to use their innate behaviors (Hancocks, 1980).

Having the opportunity to demonstrate their natural gum-foraging behavior stimulated some of the animal's other natural behaviors, i.e., compatible sharing of feeders and feeding sites (Pygmy marmosets), methods of food acquisition (marmosets and tamarins, Golden Lion tamarins and Golden-headed Lion tamarins), and territoriality and dominance (Black-tailed marmosets). Providing feeders allowed our captive animals to emulate, to some extent, the behaviors of their wild counterparts. Gum-feeders also served as a source of interest and entertainment for young marmosets (Shepardson 1989).

Providing natural wood gum-feeders to NZP animals resulted in: increased animal activity, increased animal visibility for record- keeping and general health observations, sexing of young animals, early detection of pregnancy, non-stressful medicating of sick animals, and detection and monitoring of minor injuries or dental disorders that do not require immediate medical attention.

Full-length feeders presented in vertical and diagonal orientations promote and compliment the locomotor abilities of known "vertical clingers and leapers." Using the gum-feeders required the animals to use muscles that are not exercised during quadrupedal locomotion (Garber, 1984b). They provided the animals with the opportunity to assume postures not demonstrated prior to the introduction of the feeders, and they increased the amount of available, usable cage space. Simulating gumivory improved the condition of our animals and enhanced the interest and experience of our zoo visitors.

Providing interactive ways for captive animals to gain some control of their environment results in an aesthetic, interesting, poten-tially educational, and functionally useful exhibit. Attempts at environmental enrichment, such as simulating gumivory, could simultaneously be used to help visually demonstrate the evol- tionary niche of various species while illustrating the need to conserve entire ecosystems as well as individual species.

This paper is dedicated to the memory of Yoda, a 4-year-old Black-tailed marmoset who was the catalyst for this research project.

Table 1. Documented Gum and Sap Feeders

Prosimians:	Euticus elengatulus - Needle-clawed Galago
	Galago alleni - Allen's bushbaby
	G. senegalensis - Senegal bushbaby
	G. crassicaudatus - Thick-tailed bushbaby
	Galagoides demidovii - Dwarf galago
	Perodicticus potto - Potto
Marmosets:	Callithrix argentata melanura - Black-tailed marmoset
	C. a. aurita - Buffy tufted-ear marmoset
	C. flaviceps - Buffy-headed marmoset
	C. geoffroyi - Geoffrey's marmoset
	C. humeralifer - Tassel-ear marmoset
	C. jacchus - Common marmoset
	C. j. pencillata - Black tufted ear marmoset
	Cebuella pygmaea - Pygmy marmoset
Tamarins:	Saguinus fuscicollis - Saddle-back tamarin
	S. imperator - Emperor tamarin
	S. labiatus - Red-bellied tamarin
	S. midas - Golden-handed tamarin
	S. nigricollis - Black-mantle tamarin
	S. oedipus - Cotton-topped tamarin
	S. o. geoffroyi - Geoffrey's tamarin

Lemurs:	Lemur catta - Ring-tailed lemur
	Lemur fulvus - Brown lemur
	Microcebus murinus - Mouse lemur
	Mirza coquereli - Coquerel's dwarf lemur
	Phaner furcifer - Fork-marked lemur
Squirrels:	Hylopetes spadiceus - Red-cheeked squirrel
	Microsceurus - Pygmy squirrel
	Sciurus vulgaris - Red squirrel
	Sundasciurus lowii - Low's squirrel
	S. tenuis - Slender squirrel
Old World Monkeys:	Cercopithecus aethiops - Vervet monkey
	Erythrocebus patas - Patas monkey
	Papio c. cynocephalus - Yellow baboon
	Macaca sylvanus - Barbary macaque
	Pan troglodytes - Chimpanzee
Marsupials	Gymnobelideus leadbeateri - Leadbeater's possum
	Petaurus australis - Yellow bellied glider
	P. breviceps - Sugar glider
Other Mammals:	Ursus americanus - Black bear
	Loxodonta africana - African elephant (in Amboseli)
Birds:	Artideotis kori - Kori bustard
	Coua cristata - Crested coua (Madagascar)
	Sphyrapicus varius - Yellow-bellied sapsucker

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Arguments for Single-caging of Rhesus Macaques: Are They Justified?

Viktor Reinhardt (1993), *Animal Welfare Information Center Newsletter* 6(1): 1-2, 7-8

Human primates are social by nature and strive best in the supportive environment of compatible conspecifics. Being forcefully deprived of companionship is therefore one of the most dreaded punishments. Nonhuman primates share the same basic "social needs" (36) as human primates do, and sociality is central to their very survival (2). Like human primates, nonhuman primates may become mentally disturbed when chronically kept in social isolation, and they often express their distress in abnormal behavior patterns (cf. 6).

Despite the inherent ethical problems related to social deprivation, social housing of nonhuman primates is seen as a husbandry priority only by a minority of primatological investigators (14). Thus, single-caging is still the prevailing housing condition for laboratory primates (13, 30). The regulatory "safeguard" (15) prescribing social housing (36) is apparently not very effective. The following arguments are often brought forward in justification of the traditional single-caging:

1. The animals are too aggressive to be socialized with each other.
2. Socially housed animals are at greater health risk than individually housed animals. They suffer distress from being constantly exposed to companionship. Subordinate animals become undernourished because of food competition.
3. Pair-housed animals become bored of one another.
4. Social housing interferes with research protocols.

The present paper examines the justification of these notions as they pertain to the most common laboratory nonhuman primates, i.e., rhesus macaques (*Macaca mulatta*).

Numerous studies have indeed shown that unlike in other nonhuman primate species (e.g., *Pan troglodytes*, 7; *Cebus apella*, 1; *Saimiri sciureus*, 12) group formation and subsequent group housing of rhesus macaques are likely to be associated with serious problems related to aggressive intolerance (e.g., 5, 10). Alternative pair formation and subsequent pairhousing techniques have therefore been developed for rhesus macaques (17, 18, 21, 4) in order to avoid the risk attendant on group housing. How successful are these techniques?

- No noteworthy aggression was observed when either 64 or 104 juveniles were transferred from single-caging to heterosexual and isosexual pair-housing conditions for 1 year (33, 31).

- Transferring 65 adult females and 13 adult males from single- to pair-housing arrangements with infants for 1 year was successful in 93 percent of cases (94 percent of female/infant pairs, 92 percent of male/infant pairs). Pairs were split due to aggression in 3 percent of cases. Inadequate food sharing and "teasing" accounted for the other 4 percent of pair incompatibility (31).

- Transferring 154 adult females and 40 adult males from single-caging to continuous isosexual pair-housing conditions with each other for 1 year was successful in 87 percent of cases (88 percent of female pairs, 80 percent of male pairs). Partners were separated in 6 percent of cases because one

of them seriously aggressed the other. Inadequate food sharing or depression accounted for the remaining 7 percent of partner incompatibility (31).

- Transferring 24 previously single-caged adults of both sexes to uninterrupted isosexual pair-housing conditions for 3 to 7 years was associated with pair incompatibility in 12 percent of cases, with serious aggression accounting for 3 percent. There were no indications that long-term compatibility of male pairs was less than that of female pairs, that partners did not readily adjust to new companions, or that the presence of offspring jeopardized the compatibility of companions (32).

These findings indicate that "the conventional wisdom that unfamiliar adult macaques are more likely to fight than to coexist peacefully" (11) does not hold true for the most common and, supposedly, most aggressive species, i.e., *Macaca mulatta*. The published information available provides evidence that no unreasonable risk of aggressive intolerance accrue when previously single-caged individuals are subjected to careful pair formation and subsequent permanent pair-housing protocols (c.f. 27). Pair housing effectively avoids the typical aggression problems of group housing.

The health risk associated with pair housing as compared to conventional single housing was assessed in three independent studies. In no case was clinical morbidity, as measured in the rate of veterinary treatment, higher in pair-housed than in single-housed subjects (23, 4, 35). In a study of 96 monkeys transferred from single- to compatible pair-housing conditions, subjects required veterinary treatment once every 909 days while singly caged, versus once every 2,104 days while pair housed (35). This suggests that pair housing may be an effective housing strategy not only from the behavioral but also from the veterinary point of view (35).

Three separate investigations examined the stress status of compatible pair-housed versus single-housed animals. Serum cortisol concentrations (26, 33) and immune stress response (4) of subjects did not differ in both housing conditions. Stress indices of subordinate animals were not higher than those of their dominant partners (26, 4).

Rather than being a source of distress, the compatible companion may function as a source of security (e.g., 8). This is particularly relevant for the experimental context in which the presence of a familiar conspecific functions as a buffer against environmental stress that the single-caged individual is lacking (21). Needless to say that scientific data collected from such a "stress-protected" subject are less confounded than data collected from a socially deprived research subject (cf. 3). The comforting rather than distressing effect of companionship can also be inferred from the fact that individuals afflicted with gross behavioral disorders often abandon their neurotic activities after being provided with a compatible cage mate (18, 19, 11).

Three independent studies failed to find a negative impact of pair housing on body weight development (20, 29, 4). There was also no evidence found of dominant animals gaining more body weight than their subordinate partners (20, 4). This is not surprising because adequate food sharing is an important condition to qualify a pair as compatible and allow partners to stay together (22).

The stimulatory effect of a cage mate has been evaluated in animals that have lived together as pairs for 1 year or longer. Five investigations have shown that paired companions spend approximately the same amount of time interacting with each other in species-typical ways as do wild

animals living in troops (16, 24, 29, 4, 34). This suggests that a compatible cage mate-- unlike inanimate toys--maintains its stimulatory effect over time, probably because of its inherent ever-changing nature.

It has been documented that the following research-related procedures can readily be accomplished in pair-housed rhesus macaques:

- capture from cage (28);
- blood collection in the subject's home cage (25);
- tethering (25); and
- headcap implantation (22, 25).

Procedures such as controlled food intake and urine and fecal sampling require the temporary separation of partners with transparent cage-dividing panels, allowing uninterrupted visual, olfactory, and auditory contact.

The findings presented in this report indicate that common arguments in justification of the traditional single-caging of rhesus macaques are often based on subjective assumptions rather than on scientific facts. Providing the animals a social environment in the form of compatible pair-housing arrangements does not unduly jeopardize their safety (no conspicuous aggression problems), health (no conspicuous veterinary problems), physical well-being (no signs of distress), behavioral well-being (species-typical expression of social needs; amelioration of behavioral disorders) and adequate food intake, nor does it interfere with common research procedures. Professional standards stipulate that "unless absolutely essential, primates should not be housed alone in a cage on a long-term basis" (9). The question of what makes it "absolutely essential" to deprive the majority of research rhesus macaques of social contact and social interaction by housing them permanently alone in single cages remains to be answered.

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Frequently Asked Questions About Safe Pair-housing of Macaques

Viktor Reinhardt (1996), *Animal Welfare Information Center Newsletter* 7(1): 11

Permanent pair-housing of previously single-caged macaques has become an accepted way of providing the animals with a more species-appropriate environment in the research laboratory setting. The push towards this change has come primarily from animal care personnel and veterinarians, but there is also an increasing number of scientists who recognize that macaques need social companionship for their behavioral health.

Using a simple pairing technique (1), I have transferred several hundred adult rhesus and stumptailed macaques from single-housing to isosexual pair-housing arrangements at the Wisconsin Regional Primate Research Center. There are several frequently raised questions regarding details of the pair-formation and subsequent pair-housing protocol that I want to address here for the benefit of those who want to make sure that institutionalizing pair-housing of macaques at their facility will not jeopardize the safety of the animals.

1. Why is it necessary that potential partners establish a rank relationship prior to pairing?
The dominance-subordination relationship is a basic condition for the two macaques living together. The animals do not have to engage in possibly injurious fighting but really establish such a relationship during a non-contact familiarization period in a double cage with a grated partition allowing visual, olfactory, and auditory communication. When later being introduced to each other in another cage without a partition, the subordinate partner will respect the dominance of the other, and the two therefore have no reason to fight.

2. How do I know that two animals have established a rank relationship?
Grinning, withdrawing, or turning away when being looked at or when being approached by the neighbor and threatening-against-the-observer-and-glancing-back-at-the-neighbor are indicators of subordination. A relationship is settled if any or all of these behaviors are strictly shown by only one of the two partners; this animal is the subordinate, the other is the dominant one of the dyad. Aggressive behaviors such as threatening or slamming against the cage dividing panel are not suitable to reliably determine the rank relationship between two partners.

3. How long does it take two monkeys to establish a rank relationship?
About 75 percent of the animals show clear signs of a dominance-subordination relationship within the first day of noncontact familiarization (2).

4. Can I pair the animals on the first day of familiarization?
Yes, after you have seen that one partner is subordinate to the other. It is advisable, however, to pair such animals the next morning in order to have a whole day to ascertain their compatibility.

5. Is it really necessary to pair the animals in a different double cage, rather than simply removing the grated partition?
The partners of some, but not all, pairs will engage in vicious territorial antagonism at the moment you remove the cage dividing grated panel, regardless of the fact that they already have a well-established rank relationship. It is impossible to predict which pairs will react in this way since cage

neighbors across the aisle may instigate such disputes. With the safety of the animals a priority, it is therefore recommended not to take chances but make it a rule to transfer all potential pairs into a different area where everything is strange to them except the other companion. The management of the pair-housing program can be simplified if a familiarization cage is set aside in a designated test room and potential pairs moved from there to new home cages.

6. What is the cumulative time that I have to invest to form a compatible pair?
About 30 minutes.

7. Is there a way that I can avoid subjecting paired animals to the stress associated with temporary separation during research procedures?
Many procedures--such as venipuncture, topical application of drugs, intramuscular injection, remote sampling via a tether--can be done in pair-housed animals without separating the partners. If two companions have to be physically separated -- for example, during postsurgical recovery, restraint chair experiments, metabolic experiments, food intake studies, urine/fecal collection studies --there is no reason for not allowing them to keep continual visual and auditory contact with each other with the help of a transparent cage divider or a mobile cage. Husbandry-related routine separations --for example, during TB testing, weighing, physical/pregnancy examination--are unlikely to distress the animals because they quickly learn that they are reunited after a short while.

8. Are male pairs less compatible than female pairs?
No, as long as you keep them in male-only areas to avoid sexual competition triggered by the sight of a receptive female.

9. If a pair becomes incompatible, can I pair the animals with other partners?
Yes, the sooner the better.

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The Wisconsin Gnawing Stick

Viktor Reinhardt (1997), *Animal Welfare Information Center Newsletter* 7(3-4): 11-12

Financial and labor costs often limit the implementation of environmental enrichment options, especially when enrichment should be provided for a large number of individual animals.

The Wisconsin Gnawing Stick was developed in 1987 to serve as an affordable inanimate enrichment option for caged macaques. The sticks simply consist of branch segments of dead deciduous trees. Depending on the size of the individual animal, they have a length of 12-30 cm and a radius of 2-6 cm. Sticks cut of red oak *(Quercus rubra)* branches are particularly suitable because they gradually wear into flakes that are so small that even large quantities pass through sewer drains without clogging. Branches of many other common tree species (white oak, black locust, box elder, black cherry, weeping willow, silver maple) disintegrate into relatively large strips that tend to get stuck in drains, thereby causing clogging problems.

Branches of dead trees are obtainable for no or little expense, and they can be easily cut with a bow saw into adequately sized segments. The gnawing sticks are placed into the cages without any attachment. They are cleaned with warm water daily and disinfected once every 2 weeks during the routine cage sanitation procedures.

Loose branch segments elicit the following behaviors in macaques: manipulating, gnawing, nibbling, chewing, hugging, dragging, rolling, playing, and perching. The opportunity to gnaw a chewable natural material not only counteracts boredom, but is also likely to benefit the animal's dental health (Brinkman 1996, Reinhardt 1990a, Reinhardt 1990b). Because of gradual wear and progressive dehydration, the sticks steadily change their texture and configuration, thereby retaining some novelty. After 1-6 months, they usually become so small that they have to be replaced.

In a pilot study, 25 adult, singly-caged rhesus macaques (*Macaca mulatta*) were each exposed to a regularly replaced gnawing stick for 12 months and observed thereafter. The most recently replaced stick was 1 month old. It revealed traces of wear in 96 percent of cases and was actively used by the animals 0 to 20.6 percent of the time with a mean of 3.3 percent (Reinhardt 1989).

In a later assessment, 60 pair-housed rhesus macaques of different age classes (42 adults 9-30 years old, 18 sub-adults 3.5-4 years old) were exposed to gnawing sticks for 18 months and observed thereafter. Each pair had continuous access to two sticks that had been replaced 1 week before the test observation. The sticks showed traces of wear in 100 percent of cases. Individuals were engaged in stick use on average 4.8 percent of the time, with subadults spending significantly more time with the sticks than adults (9.5 percent versus 2.8 percent) (Reinhardt 1990b). In a comparative study with 20 adult pair-housed stumptailed macaques, individuals were actively engaged with their gnawing sticks 2.2 percent to 28.2 percent of the time with a mean of 5.7 percent (Reinhardt 1990a).

In addition to perches and social companionship, red oak gnawing sticks were implemented at the Wisconsin Regional Primate Research Center as basic cage enrichment in 1989. All caged rhesus macaques (more than 700 animals) and all caged stumptailed macaques (approximately 36 animals) have continual access to gnawing sticks since that time. This simple and inexpensive enrichment

technique provides the animals with sustained species-adequate stimulation for the expression of species-typical behaviors. Long-term exposure to the sticks has resulted in no recognizable health hazards (compare with Line and Morgan 1991).

Acknowledgments

I am very thankful to the Cowley family for granting me permission to cut more than 5,000 gnawing sticks from dead red oaks on their farm without charge.

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Appendix A: USDA Final Rule on Environment Enhancement to Promote Psychological Well-Being--Section 3.81

In response to a Congressional amendment to the Animal Welfare Act, USDA must write regulations. The regulations explain what affected parties must do to comply with the amendment. USDA issues proposed rules which are published in *Federal Register* and open for public comment. After comments are received, USDA issues a final rule in which changes to the proposed rule may or may not be made based on public input. The final rule below is USDA justification for the new regulations and responses to the many comments received by the department. The final rule is then incorporated into *Title 9, Code of Federal Regulations*.

02/15/91 Vol. 56, No. 32, *Federal Register*, Pages 6426-6505

DEPARTMENT OF AGRICULTURE
Animal and Plant Health Inspection Service
9 CFR Part 3
[Docket No. 90-218]
RIN: 0579-AA20
Animal Welfare; Standards

AGENCY: Animal and Plant Health Inspection Service, USDA.
ACTION: Final rule.
Environment Enhancement to Promote Psychological Well-Being--Section 3.81

In proposed Sec. 3.81, titled "Environment enhancement to promote psychological well-being," we proposed that dealers, exhibitors, and research facilities be required to develop, document, and follow a plan for environment enhancement adequate to promote the psychological well-being of nonhuman primates. We proposed to require that the plan be in accordance with the currently accepted professional standards as cited in appropriate professional journals or reference guides and as directed by the attending veterinarian. We also proposed to require that the plan be made available to APHIS, and, in the case of research facilities, to officials of any pertinent Federal funding agency. We proposed to require that the plan address certain specified areas, including: (1) Social grouping; (2) environmental enrichment; (3) special considerations of nonhuman primates requiring special attention; and (4) restraint devices.

A very large number of commenters supported in general the promotion of psychological well-being in nonhuman primates. A number of others requested that "psychological well-being" in nonhuman primates be defined. A number of commenters stated either that the term is undefinable and cannot be measured as an improvement for nonhuman primates, that it is impossible to establish valid standards for the animals' psychological well-being, that the proposed standards might be detrimental to nonhuman primates, that the proposed regulations regarding psychological well-being were excessive, or that the proposed standards were not based on scientific analyses. As we discussed in our proposal, what constitutes psychological well-being in each species and each primate does not lend itself to precise definition. As an agency, however, we are mandated by Congress to establish standards to promote the psychological well-being of nonhuman primates. As we discussed earlier, the information received from the expert committee on primates, consultations with HHS, other

experts in primates, and the large number of comments received on the subject, demonstrate that the psychological well-being of nonhuman primates involves a balance of several factors or areas of concern. This concept involves sufficient space for the animals; methods to stimulate the animals and occupy some of their time, both physically and mentally (i.e., environment enrichment); and methods of social interaction with other nonhuman primates or humans.

The promotion of the psychological well-being of nonhuman primates is a critical component in our rewriting of the animal welfare regulations, and is one that we are specifically mandated to address under the Act. Statutorily, we have the responsibility and obligation to establish such provisions as we believe are necessary for a physical environment to promote the animals' psychological well-being, but do not have the authority to interfere with actual research.

One commenter stated that the regulations should not limit resource materials for the development of environment enhancement plans to professional journals and reference guides. The regulations as proposed require adherence to such information sources as a minimum. They do not prohibit the use of other research sources in establishing the required plans.

A large number of commenters urged that the regulations include specific requirements for exercise and social grouping of nonhuman primates, as proposed in our original proposal. We disagree with the commenters that it would be in the best interests of nonhuman primates to impose uniform rigid standards on all facilities. Because of the diverse needs of varying species and individual animals, it might actually prove harmful to establish the same set of specific standards for all animals.

A small number of commenters stated that any release of nonhuman primates for exercise and social interaction should be documented. We do not consider such documentation necessary for enforcement purposes. With the requirement for a written plan, and inspections by Department personnel, we do not expect enforcement problems with the regulations as proposed.

We are making two additions to Sec. 3.81 as proposed to clarify our intent. That section requires that the plan for environment enhancement be made available to APHIS. It was our intent that the plan be made available upon request. We are therefore adding language to Sec. 3.81 as proposed to clarify that intent. Additionally, we are specifying that the required plan for environment enhancement must be an appropriate one.

Social Grouping.

We proposed in Sec. 3.81(a) that the environment enhancement plan include specific provisions to address the social needs of nonhuman primates of species known to exist in social groups in nature. As proposed, such specific provisions must be in accordance with currently accepted professional standards, as cited in appropriate professional journals or reference guides, and as directed by the attending veterinarian.

A number of commenters opposed the proposed provisions regarding the social needs of nonhuman primates. Several commenters said the proposed provisions were vague and should be clarified, or that more specific criteria for meeting social needs should be set forth. Many others offered specific recommendations for addressing the animals' social needs. The proposed provisions regarding the social needs of primates were intentionally written so as to allow some flexibility and professional

discretion to individual facilities in meeting the social needs of the animals. Exactly how the animals' social needs are met is of less importance than the fact that they are met.

One commenter stated that requiring that the social needs of nonhuman primates be met exceeds the intent of Congress. We do not agree with the commenter. In general, nonhuman primates are social animals, with the need for socialization constituting a significant component of their psychological makeup. Promotion of the animals' psychological well-being requires that their social needs be addressed.

A small number of commenters stated that caging nonhuman primates for their lifetime has proven to be advantageous both to the animals' care and to their welfare. We disagree that individually housing nonhuman primates, without addressing their psychological and social needs, is adequate to promote their psychological well-being. Such practices will not be in compliance with these regulations.

A number of commenters stated that social housing should not be mandatory, but rather should be one of the possible methods of enriching the animals' environment. Other commenters stated that multiple housing of animals is inappropriate in most cases. One commenter stated that socialization should be based on individual housing that allows for visual and auditory contact among nonhuman primates, rather than group housing. One commenter stated that, under the regulations as proposed, facilities might be precluded from housing only one nonhuman primate. We are making no changes based on these comments. The regulations as proposed do not specifically call for group housing of nonhuman primates. They do, however, require that the social needs of nonhuman primates be addressed. In most cases, we expect group housing to be the most efficient and appropriate method of ensuring that the animals' social needs are met.

Many commenters stated that social grouping would endanger the animals' welfare by increasing noise and fighting. We are making no changes based on these comments. The regulations in proposed Sec. 3.81(a)(3) require that nonhuman primates be compatible before being housed together. A number of other commenters, while supporting in general group housing of nonhuman primates, stated that in certain cases it might be inappropriate and detrimental. We agree that such situations might exist, and consider them to be already addressed in Sec. 3.81(a)(3) as proposed.

A small number of commenters stated that housing primates in groups will facilitate spread of infectious diseases. We consider the regulations as proposed adequate to prevent the spread of disease among group-housed animals. Section 3.81(a)(2) as proposed requires the isolation of nonhuman primates that have or are suspected of having a contagious disease. Additionally, the cleaning and sanitization requirements elsewhere in the regulations as proposed are designed to minimize disease introduction and spread.

A number of commenters expressed concern that group housing of nonhuman primates would result in increased physical and mental stress and trauma to animal handlers. As we discussed in our proposal, while we agree that housing primates in groups presents some logistical concerns that are not present when animals are housed individually, we believe that such concerns can be addressed by proper training of handlers and appropriate housing configurations.

A small number of commenters stated that meeting the requirements regarding the social needs of nonhuman primates will require facilities to increase their staffs. One commenter expressed concern

that providing for group housing for primates will involve significant expense. We do not agree that compliance with the regulations as proposed will necessarily require large staffing increases. In any event, some additional staffing, if necessary, would not be unreasonable in response to the amendments to the Act. Whether additional staffing is needed will depend on how the facility meets the social needs of the nonhuman primates, on the physical configuration of the facility, and on the facility's method of operations. In some cases, housing animals in groups is less labor-intensive than housing them individually.

One commenter asserted that individually housing primates is appropriate in cases where the animal is used in experiments lasting 12 months or less. We are making no changes based on this comment. The Act does not distinguish between animals kept for a short term and those kept long-term, and requires minimum standards for all animals, regardless of the duration involved. The commenter presented no evidence to support the conclusion that individual housing for 12 months or less is not psychologically distressing to nonhuman primates, and we are not aware of scientific data supporting such a conclusion.

A small number of commenters stated that the fact that primates socialize in nature neither indicates nor suggests that they are psychologically harmed by eliminating contact with other nonhuman primates. We disagree. In general, nonhuman primates are social animals by nature. In providing for the psychological well-being of nonhuman primates, such social needs must be taken into account. Other commenters stated that social grouping has not been proven to assure psychological well-being or to prevent development of stereotypical behaviors. We are making no changes based on these comments. No practices or regulations can guarantee the psychological well-being of nonhuman primates in all cases. However, the most compelling evidence available indicates that certain practices, including housing nonhuman primates in groups, can promote psychological well-being. In general, housing in groups promotes psychological well-being more assuredly than does individual housing. On the other hand, individual housing has been demonstrated to give rise to significantly more stereotypical behavior than does group housing.

A small number of commenters recommended that compatible groups of nonhuman primates be required to remain together. Others recommended that primate infants remain with their dam for a minimum number of years, ranging from 2 years to 4 years. A small number of commenters recommended that the regulations allow primate families to be housed together. Others requested that such housing be required. One commenter stated that conspecifics should be housed together whenever possible. While we encourage such practices where possible, and nothing in the regulations as proposed prohibits them, we do not consider them practical in all cases. We are therefore making no changes based on these comments.

A small number of commenters suggested that behavioral scientists or animal psychologists may be more qualified than attending veterinarians to establish environment enhancement plans. Under the regulations as proposed, the attending veterinarian has responsibility for directing the development of the plan. However, nothing in the proposed regulations prohibits consultation with other animal experts. On the contrary, we expect the attending veterinarian to carry out whatever consultation and professional research he or she deems necessary to adequately advise the facility. One commenter stated that at research facilities, the environment enhancement plan should be designed based on consultation with and review by the Committee. As noted, the attending veterinarian may consult as necessary in directing development of the plan. Further, at research facilities, animal care programs

are subject to annual review by the Committee.

A large number of commenters stated that group housing could significantly interfere with research where social grouping, or the lack of it, is a factor. Conversely, a very large number of commenters stated that exemptions for research should be allowed only if it can be documented that social housing is interfering with the research. Under Sec. 2.38(k)(1) of part 2 of the regulations, research facilities are required to comply with the standards in part 3, except in cases where exceptions are specified and justified in the research proposal to conduct the specific activity and are approved by the facility's Committee. This provision exists to safeguard approved research.

In order to make clear situations where group housing would not be appropriate, we proposed to specify in Secs. 3.81 (a)(1), (a)(2), and (a)(3) that the environment enhancement plan may provide that: (1) A nonhuman primate that exhibits vicious or overly aggressive behavior, or is debilitated because of age or other conditions should be housed separately; (2) a nonhuman primate or group of nonhuman primates that has or is suspected of having a contagious disease must be isolated from healthy animals in the colony as directed by the attending veterinarian; and (3) nonhuman primates may not be housed with other species of nonhuman primates or animals unless they are compatible, do not prevent access to food, water, and shelter by individual animals, and are not known to be hazardous to the health and well- being of each other. We also proposed that compatibility of nonhuman primates must be determined in accordance with generally accepted professional practices and actual observations, as directed by the attending veterinarian, to ensure that the animals are compatible. Additionally, we proposed that individually housed nonhuman primates must be able to see and hear nonhuman primates of their own or compatible species, unless the attending veterinarian determines that it would endanger their health, safety, or well- being. A small number of commenters expressed opposition to all individual housing of nonhuman primates. We consider it obvious that situations will arise where housing in groups is self-evidently more harmful than helpful, and are making no changes based on the comments.

A small number of commenters stated that the specific provisions described in the preceding paragraph should be deleted, because, according to the commenters, they all fall under the category of currently accepted professional standards. We consider the provisions in question minimum standards applicable in all situations. We are therefore making no changes based on the comments.

Environmental Enrichment

In proposed Sec. 3.81(b), we proposed to require that the plan discussed above include provisions for enriching the physical environment in primary enclosures by providing means of expressing noninjurious species-typical activities, and to provide that species differences should be considered when determining the type or methods of enrichment. We provided in the proposal that examples of environmental enrichments include providing perches, swings, mirrors, and other increased cage complexities; providing objects to manipulate; varied food items; using foraging or task-oriented feeding methods; and providing interaction with the care giver or other familiar and knowledgeable person consistent with personnel safety precautions.

Many commenters stated that the regulations should list all of the specific areas that must be addressed in an environmental enrichment plan. Some commenters expressed concern that the lack of a guide in choosing environment enrichments could result in prolonged experimentation at the

expense of the primates' health and research funds. A number of commenters submitted specific practices that they believed should be included in achieving environmental enrichment. One commenter recommended that the Department set forth an exhaustive list of unacceptable practices. The provisions in Sec. 3.81 of the proposal set forth broad standards that must be met to ensure the psychological well-being of nonhuman primates. Section 3.81(b) is more specific, requiring enrichment of the physical environment by providing means of expressing species-typical activities. Examples of such enrichment are provided. Beyond this, however, we do not consider it appropriate to attempt to set forth an exhaustive list of methods of achieving environmental enrichment. Because of the many variables affecting how best to enrich the environment for species and animals that have different needs and that are held under differing conditions, such a listing would be unnecessarily restrictive, and would not allow for advances in animal behavioral research. Nor do we consider it possible or necessary to set forth a comprehensive list of unacceptable practices. Practices will be considered unacceptable if they do not promote compliance with the standards in Sec. 3.81 as proposed.

Several commenters recommended that a panel of experts in primatology should be formed to develop standardized plans for environmental enrichment of nonhuman primates. For the reasons set forth in the preceding paragraph, we do not consider it appropriate to attempt to set forth a comprehensive listing of specific standards for environmental enrichment. A committee of the nature described by the commenters was convened prior to the initiation of this rulemaking process. We have drawn on the recommendations of that committee in developing this rulemaking.

One commenter stated that the regulations should list what species-typical behaviors are required, because all behaviors are not possible in a cage. We do not consider such a change practical or necessary, and expect common sense, along with professional judgment, to assist in determining what behaviors can and should be promoted in caged animals.

One commenter stated that professional standards for environmental enrichment do not exist. We disagree. While we welcome additional research with regard to environmental enrichment, sufficient professional consensus already exists to make plans for such enrichment appropriate. A small number of commenters stated that there is no definable species-typical behavior in captive nonhuman primates. We disagree. Species-typical behavior has been defined in both wild and captive populations, and sufficient data exists to meet the standards as proposed.

Special Considerations

In Sec. 3.81(c) of the proposal, we proposed that certain categories of nonhuman primates must receive special attention regarding enhancement of their environment. We proposed to require facilities to provide for the special psychological needs of (1) infants and young juveniles, (2) those that show signs of being in psychological distress through behavior or appearance, (3) those used in research for which the Committee-approved protocol requires restricted activity, (4) individually housed nonhuman primates that are unable to see and hear nonhuman primates of their own or compatible species, and (5) great apes weighing over 110 lbs. (50 kg).

As proposed, this special attention would be based on the needs of the individual species and in accordance with the instructions of the attending veterinarian. Some examples of special attention would be special feeding plans for juveniles, and increased one-on-one care for animals showing

psychological distress.

A small number of commenters requested that additional criteria be provided as to what constitutes special attention. We are making no changes based on these comments. The form this special attention must take will depend to a great extent upon what form of environment enhancement is afforded all of the nonhuman primates in a facility under the required plan. Rather than restrict forms of special attention to a finite list, we consider it appropriate as proposed to base the special attention on the needs of the individual species, in accordance with the instructions of the attending veterinarian.

Several commenters stated that, at research facilities, the Committee and not the attending veterinarian should determine what special attention is necessary. We consider it appropriate in general to give responsibility for determining appropriate special attention to the attending veterinarian. However, the regulations do not prohibit consultation with the Committee.

A number of commenters addressed the requirement for special attention for nonhuman primates that show signs of being in psychological distress through behavior or appearance. A small number of commenters recommended that the term "psychological distress" be changed to "psychological pathology," because, according to the commenters, psychological distress can be of a transient or insignificant nature. We consider the term "psychological distress" to better convey our intent that facilities remedy even transient psychological disturbances than does the change recommended by the commenters, and are making no changes based on these comments. A small number of commenters stated that if a nonhuman primate exhibits stereotypical movements, such as hair pulling or similar signs of psychological distress, consultation with outside experts should occur. Under the regulations, a facility is required to provide adequate veterinary care to its animals. In certain cases, the attending veterinarian may consider it necessary to conduct outside consultation in administering such care. However, we do not consider it necessary or practical to include in the regulations a compendium of what constitutes adequate veterinary care. One commenter requested that the regulations include a definition of "psychological distress." We consider the provision in question to be clear as written. Any behavior or appearance that would indicate abnormal stress must be addressed.

One commenter requested that the regulations include examples of restricted activity in research situations that would require special attention. We are making no changes based on this comment. The nature of restricted activity deemed necessary under a research protocol is subject to approval by the Committee. We do not consider it appropriate to attempt to enumerate in the regulations examples of restrictions that are the responsibility of the Committee.

Several commenters recommended that the provisions in Sec. 3.81(c)(5) as proposed be broadened to require special attention for great apes other than those weighing over 110 lbs. (50 kg). We are making no changes based on these comments. The special attention to be provided great apes over 110 lbs. is related to their need for additional space over that required for other great apes in Sec. 3.80. For this reason, we do not consider it necessary to require special attention for the smaller great apes.

Restraint Devices

We also proposed that the plan to be developed by the facility include provisions addressing restraint devices. We proposed that nonhuman primates must not be maintained in restraint devices unless required for health reasons as determined by the attending veterinarian, or by a research proposal approved by the Committee at research facilities. As proposed, maintenance under such restraint would be limited to the shortest period possible. We proposed that, in instances where long-term (more than 12 hours) restraint is required, the nonhuman primate must be provided the opportunity daily for unrestrained activity for at least one continuous hour during the period of restraint, unless continuous restraint is required by the research proposal approved by the Committee at research facilities.

A small number of commenters supported the proposed provisions regarding restraint devices as written. A small number of commenters stated that the proposed exercise period for restrained nonhuman primates is insufficient. Upon review of the comments, we continue to consider release for one continuous hour during the period of restraint adequate to promote the animal's well-being, and are making no changes based on these comments.

A small number of other commenters recommended that it be required that restrained nonhuman primates receive social contact with a conspecific primate during the exercise period, and that all animals placed in restraint devices with the approval of the facility's Committee be inspected by the Committee prior to the Committee's granting approval for use of the restraint device. We are making no changes based on these comments. The special needs of restrained animals are already addressed in Sec. 3.81(c)(3) as proposed. Further, the restraint of animals must be reviewed by the Committee at least twice annually, in accordance with part 2 of the regulations. Similarly, the recommendation of the commenter who suggested that the Committee be required to investigate alternatives before approving research protocols is already addressed in Sec. 2.31(d)(1)(ii) of part 2 of the regulations.

A small number of commenters expressed concern that requirements for the exercise of restrained animals would interfere with research protocols. Some of these commenters recommended that requirements for restrained animals be left to the Committee. We disagree that the provisions as proposed regarding restrained animals would interfere with research. Under Sec. 2.38(k)(1) of part 2 of the regulations, exceptions to the standards in part 3 may be made when such exceptions are specified and justified in the proposal to conduct an activity and are approved by the Committee. For this reason, we are not adopting the recommendation of the commenter who stated that continuous restraint for more than 12 hours should be prohibited in all cases.

A small number of commenters requested that the regulations differentiate between restriction of movement and restraint. We are making no changes based on these comments. The regulations as proposed clearly pertain to maintenance in restraint devices. We consider the reference adequate to convey our intent as written.

Exemptions--Section 3.81(e)

In Sec. 3.81(e)(1) of the proposal, we proposed that the attending veterinarian may exempt individual nonhuman primates from participation in environment enhancement plans because of their health or condition, or in consideration of their well-being, and must document the basis of such exemptions

for each nonhuman primate. The basis of the exemption would have to be recorded by the attending veterinarian for each nonhuman primate. Unless the basis for an exemption is a permanent condition, it would be required that the attending veterinarian review the exemption at least every 30 days.

We proposed in Sec. 3.81(e)(2) of the proposal that the research facility's Committee may exempt individual nonhuman primates from some or all of the environment enhancement plans, for scientific reasons set forth in the research proposal. We proposed to require that the basis of such exemption be documented in the approved proposal and be reviewed at appropriate intervals as determined by the Committee, but not less than annually.

We additionally proposed to require that records of any exemptions be maintained by the dealer, exhibitor, or research facility and be made available to USDA officials or officials of any pertinent funding Federal agency upon request.

A small number of commenters expressed opposition to what they termed "loopholes" in the regulations, which they stated would allow researchers to house animals in isolation merely by claiming necessity. As discussed above, we do not have the authority to interfere with approved research, and are making no changes based on these comments. Several commenters opposed exemptions of any sort. Permitting exemptions based on approved research protocols is consistent with the provisions of the Act that we not interfere with the design, outlines, or guidelines of actual research. It may be necessary to the health and well-being of the animals to allow for exemptions for medical reasons. We are therefore making no changes based on these comments.

A number of commenters stated that the provisions for exemptions will require excessive paperwork, will be costly, and will subject the attending veterinarian's opinion to unqualified review. Throughout these regulations, we have attempted to minimize recordkeeping requirements. However, we continue to consider it necessary in facilitating inspection and enforcement that exemptions from the environment enhancement plan granted by the attending veterinarian be documented and be subject to review by the Department. We do not agree that it is necessary, however, as one commenter recommended, that documentation of exemptions be provided to the Department. Under the proposed regulations, these records must be made available to APHIS upon request. We consider that provision adequate to ensure proper inspection and enforcement.

A small number of commenters stated that exemptions should be reviewed by the attending veterinarian "as needed," rather than every 30 days as proposed. We are making no changes based on these comments. Because of the importance accorded the promotion of the psychological well-being of nonhuman primates under the Act, and because medical conditions in many cases change frequently, we consider it necessary and appropriate to ensure that exemptions to the environment enhancement plan be reviewed on a regular basis, to ensure that the exemptions are not in effect any longer than is necessary.

A small number of commenters stated that the facility should designate the individual most qualified to grant exemptions, because the attending veterinarian may not be the most qualified individual available with regard to animal behavior, and seldom has contact with nondiseased primates. A small number of commenters stated that the Committee, and not the attending veterinarian, should have final authority at research facilities with regard to exemptions. We are making no changes based on these comments. The exemptions granted by the attending veterinarian will be for medical reasons,

which he or she is qualified through training to assess.

Several commenters stated that the attending veterinarian should be permitted to exempt either individual nonhuman primates or groups of nonhuman primates from participation in the environment enhancement plan, and that exemptions for permanent conditions, including old age, should not need to be reviewed every 30 days. We do not agree. To ensure each nonhuman primate's participation in the environment enhancement plan to the fullest extent possible, exemptions need to be made on an individual basis, according to the health, condition, and well-being of the animal. No blanket exemptions for groups or conditions are acceptable.

Several commenters recommended that it be required that exemptions made by the Committee be reviewed every 30 days. We do not agree with the commenters' recommendation. Exemptions made by the Committee will be made for reasons relating to an approved research protocol. Such exemptions are not subject to as rapid change as exemptions for medical reasons, and do not need to be reviewed as often as those for medical reasons.

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